MONOPOLY MONEY: REAPING THE ECONOMIC AND ENVIRONMENTAL BENEFITS OF MICROGRIDS IN EXCLUSIVE UTILITY SERVICE TERRITORIES

INTRODUCTION

Policy-makers, the business community, and members of the public are increasingly aware that "[e]nergy is fundamental to U.S. domestic prosperity and national security."[1] Each of the last seven presidents has committed to improving the nation's energy outlook; each one has failed to resolve the issue.[2] Energy demand is growing rapidly, and our aging infrastructure is increasingly ill-equipped to support that growth. The environmental impacts of traditional power generation include asthma-inducing particulate matter, pollutants that cause acid rain, and the carbon that is primarily responsible for global climate change.[3] Complete reliance on the traditional grid threatens the reliability of the American energy supply, as evidenced by the 2000–2001 energy crisis in California[4] and the Northeast Blackout of 2003.[5] Conventional wisdom holds that addressing these issues by transitioning to a more sustainable energy economy is a zero sum game, i.e. that updating our energy system will impose major economic costs and disrupt critical services. Increasingly, however, scholars such as Amory Lovins have begun to argue that "[t]he world abounds with proven ways to use energy more productively, and smart businesses are leaping to exploit them."[6] As more private-sector stakeholders recognize this opportunity, particularly in a time of economic stress, they encourage regulators to allow for new approaches to generating and distributing electricity.

One emerging approach to high-productivity energy distribution is the "microgrid." A microgrid is a distribution system that allows locally generated energy to be transmitted to nearby communities, campuses,

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1. Timothy E. Wirth et al., *The Future of Energy Policy*, 82 FOREIGN AFF., July–Aug. 2003, at 132, 132.

2. *Id.* at 134.

3. World Coal Institute, Coal Use and the Environment, http://www.worldcoal.org/coal-the-environment/coal-use-the-environment/ (last visited Feb. 28, 2010) (discussing coal use and the environment and stating that "[p]articulates can affect people's respiratory systems . . .").

4. JOSEPH P. TOMAIN & RICHARD D. CUHADY, ENERGY LAW IN A NUTSHELL 285–89 (2004).

5. *See* U.S.–CAN. POWER SYSTEM OUTAGE TASK FORCE, INTERIM REPORT: CAUSES OF THE AUGUST 14TH BLACKOUT IN THE UNITED STATES AND CANADA 21–43 (2003) (describing the causes of the 2003 blackout). *See generally* 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) (discussing in greater detail the harms caused by the blackout and potential strategies for averting such harms in the future).

6. Amory Lovins, *More Profit with Less Carbon*, SCI. AM., Sept. 2005, at 74.

businesses, and industrial facilities.[7] Many renewable technologies are not reliable enough or cost-effective enough to be implemented on a large scale.[8] Microgrids would allow renewable technologies to meet significant demand while still operating in small-scale applications, mitigating the problems of intermittency while spreading their cost.[9] Implementing distributed generation technology would lessen the demand placed on the traditional grid, improve reliability by providing an alternate power source when the traditional grid fails, and promote the increased use of renewable fuels.[10] Distributing locally generated power would also significantly reduce supply-side inefficiencies by cutting line losses over long transmission distances.[11] Microgrid distribution systems would allow electricity consumers to take full advantage of these benefits.

This Note recommends a statutory scheme that states should adopt to take advantage of the benefits provided by microgrids and overcome regulatory barriers to their construction. Part I offers a technical description of microgrids and details the ways in which their widespread adoption would be critical to solving America's energy challenges. Part II describes the historic progression of energy regulation in the United States and explains how this history has created barriers to microgrid implementation. This Part discusses how the regulatory environment has been shifting since the mid-1950s and examines how these shifts might impact microgrids. Specific examples of these changes include utility tariffs and regulatory structures in states that have taken significant steps to promote microgrid technology. This Part will also detail the relevant provisions of those statutes and discuss how they apply to the microgrid permitting process. Finally, Part III will suggest a regulatory scheme that would overcome regulatory barriers to microgrids and encourage developers to invest in their construction.

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7. *See* Z. YE ET AL., NAT'L RENEWABLE ENERGY LABORATORY, FACITLIYY MICROGRIDS iii (2005), *available at* http://www.nrel.gov/docs/fy05osti/38019.pdf ("Microgrids are envisioned as local power networks that use distributed energy resources and manage local energy supply and demand.").

8. *See, e.g.*, TOMAIN & CUHADY, *supra* note 4, at 358 (stating that "renewable energy will become a larger part of the nation's energy picture to the extent that it becomes cost-effective"); *see also id.* at 361 (explaining that the most significant constraint on the use of renewable sources like wind is their variability).

9. NAVIGANT CONSULTING, MICROGRIDS RESEARCH ASSESSMENT--PHASE 2, 11 (Final Report 2006), *available at* http://der.lbl.gov/sites/der.lbl.gov/files/montreal_navigantmicrogridsfinalreport.pdf.

10. *Id.*

11. *Id.* at 14.

I. MICROGRIDS ARE AN EMERGING TRANSMISSION TECHNOLOGY THAT PUBLIC SERVICE COMMISSIONS ARE BEGINNING TO RECOGNIZE AS A TOOL TO ENCOURAGE RELIABILITY, SUSTAINABILITY, AND IMPROVED SECURITY IN ELECTRICITY MARKETS

A. Microgrids are electric distribution systems that make distributed generation resources available to small groups and communities without isolating them from the grid

A microgrid is "an electric *distribution system* that *ties together* two or more distributed generation resources. It relies on its own wires, but is designed to interconnect to the traditional electric distribution grid at at least one point of common coupling."[12] Distributed generation resources, or distributed energy resources (DERs), are "smaller electric generators and generators that are closer to the load . . . [and utilize] new technologies for generating mostly under 50 megawatts, including photovoltaics, microturbines, fuel cells, as well as others . . . ."[13] Figure 1, below, illustrates the difference between a conventional single DER and a microgrid system.

Microgrids exist in a number of different models. "Utility microgrids" are owned and managed by a distribution utility to reduce customer costs and increase reliability.[14] "Landlord microgrids" are installed and managed by a single landlord to provide heat and power to tenants as a part of their lease agreements.[15] Under the "co-op" model, individuals or firms cooperatively own and manage a microgrid to serve their own power needs.[16] A "customer-generator microgrid" is owned and managed by a single individual or firm.[17] That individual entity sells electricity or heat to its neighbors.[18] Finally, under the "district heating" model, an independent firm owns and manages a microgrid and sells power and heat to multiple

12. FREDERICK R. FUCCI, ARNOLD & POTTER LLP, ALTERNATIVE ENERGY IN COMMERCIAL REAL ESTATE AND MULTI-FAMILY HOUSING: APPLICATION OF DISTRIBUTED RESOURCES AND PRACTICAL AND LEGAL RAMIFICATIONS, REAL ESTATE LAW AND PRACTICE COURSE HANDBOOK SERIES 48 (2008), *available at* http://www.arnoldporter.com/resources/documents/PLI_March2008_PaperOnAlternativeEnergy3.pdf (emphasis added).

13. TOMAIN & CUHADY, *supra* note 4, at 371.

14. Douglas E. King, Electric Power Micro-grids: Opportunities and Challenges for an Emerging Distributed Energy Architecture 60 (May 2006) (unpublished Ph.D. dissertation, Carnegie Mellon University), *available at* http://wpweb2.tepper.cmu.edu/ceic/pdfs_other/Doug_King_PhD_Thesis_2006.pdf.

15. *Id.*

16. *Id.*

17. *Id.*

18. *Id.*

customers, who are served under contract.[19] The utility and landlord models tend to get the least resistance from regulators, while the district heating model is strongly disfavored.[20]

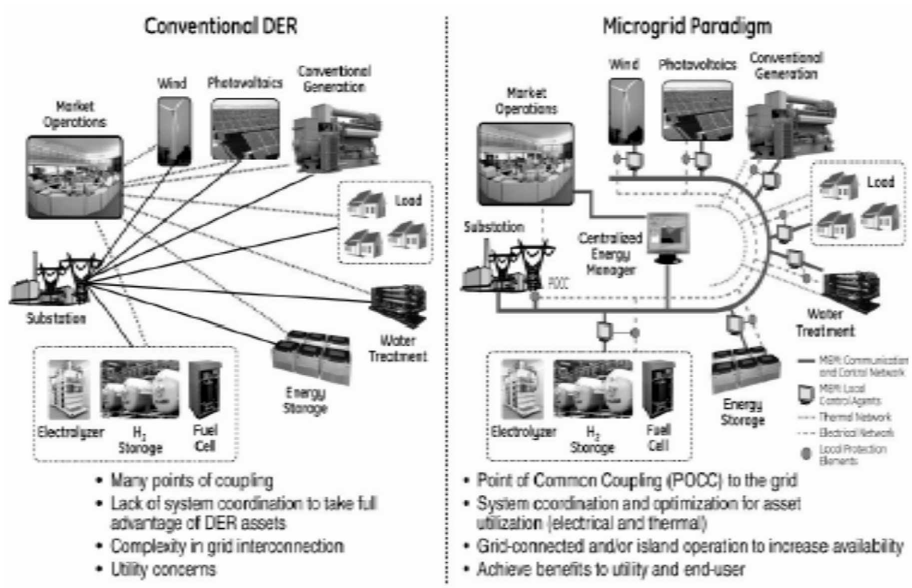

Figure 1: Conventional DER and Microgrid Paradigm[21]

These models exist under three connection classifications.[22] "Islanded" microgrids are completely separate from the main grid.[23] Microgrids that are "interconnected at distribution voltages" are connected to the grid at the consumer level.[24] Distribution voltages are the only classification relevant in this discussion because islanded grids cannot conflict with monopoly laws, as they do not sell power on the grid.[25] Each of these applications connect through their own wires, but are also hooked up to the larger electric grid, as Figure 2, below, illustrates.

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19. *Id.*
20. *Id.*
21. U.S. DEP'T OF ENERGY ET AL., MICROGRID DESIGN, DEVELOPMENT & DEMONSTRATION, 321 (2006), *available at* http://www.electricdistribution.ctc.com/pdfs/ge-DOE_Minigrid_March06_v2.pdf.
22. King, *supra* note 14, at 61.
23. *Id.*
24. *See id.* (stating that interconnection at high voltages generally indicates participation in wholesale markets).
25. *See id.* (stating that "an islanded micro-grid refers to the creation of a system that is never interconnected with the area grid" and as a result could be granted greater flexibility by state regulators and might not be subject to regulation).

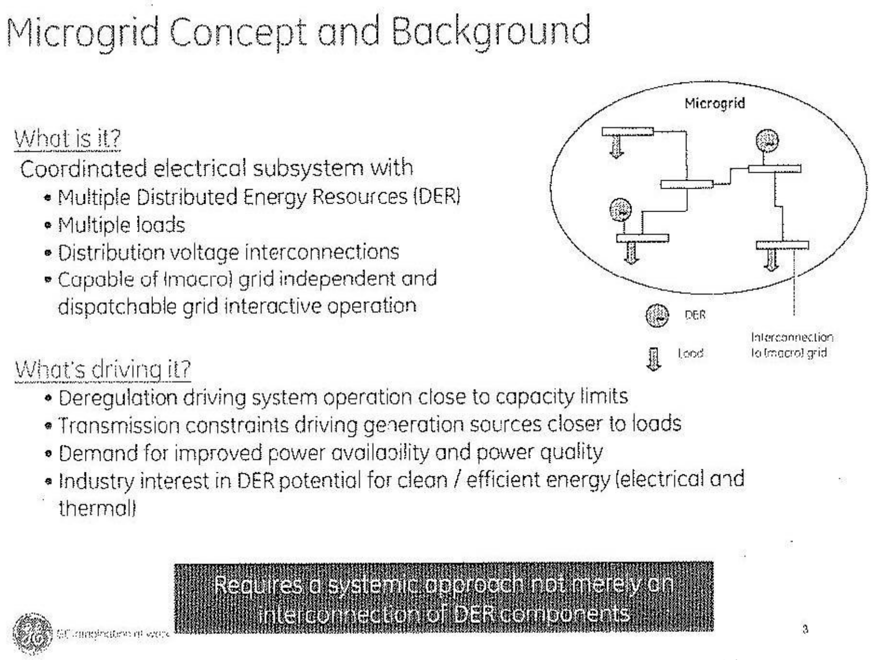

Figure 2: Microgrid Concept and Background[26]

B. Microgrids provide extensive security, reliability, and environmental benefits while encouraging innovation, but they also present unique challenges

Microgrid applications have the potential to provide significant economic and environmental benefits to users. Microgrids reduce the need for new generation capacity, drive innovation, and lower costs by promoting competition with established or "legacy" utilities.[27] They also promote the use of renewable power by providing an opportunity for small-scale wind and solar applications to connect to the grid and manage their intermittency.[28] Advisors to the U.S. Department of Energy (DOE) highlight these benefits while noting that microgrids increase the resiliency and security of the overall grid by dispersing power resources and making it easier to provide different

26. U.S. DEP'T OF ENERGY ET AL., *supra* note 21, at 3.

27. DOUGLAS KING & M. GRANGER MORGAN, CARNEGIE MELLON ELEC. POWER INDUS. CTR. GUIDANCE FOR DRAFTING STATE LEGISLATION TO FACILITATE THE GROWTH OF INDEPENDENT ELECTRIC POWER MICRO-GRIDS 1 (2004), *available at* http://wpweb2.tepper.cmu.edu/ceic/PDFS/CEIC_ 03_17.pdf [hereinafter ELECTRIC POWER INDUSTRY].

28. *See id.* ("Today it is technically possible, and sometimes economically attractive, for small 'micro-grid' companies to establish local distribution systems underneath the traditional (or 'legacy') electric power distribution system.").

levels of service to different classes of customers at tailored price points.[29] The market for microgrids is driven by their ability to reduce the cost and manage the volatility of energy markets.[30] DOE advisors estimate that microgrids can achieve almost a billion dollars per year in benefits to the American public by 2020 if widespread implementation begins in 2015.[31] This figure includes the elimination of 17.4 million tons of CO_2 emissions; 108,000 tons of SO_x emissions; 18,000 tons of NO_x emissions; "$360 [million] in energy savings due to 10% reduction in energy bills . . . "; and avoided costs from forty or more communities that can have complete energy service during grid outages due to the availability of auxiliary microgrid power.[32] Microgrid proliferation will also provide 200 megawatts of renewable energy deployed within microgrids.[33]

Microgrids can accommodate a number of different generation technologies, each with its own benefits and costs. Currently, diesel generator applications are the most common.[34] Natural gas is gaining ground, however, as it is available, affordable, and has a smaller environmental footprint than traditional diesel fuel.[35] Other currently installed or planned microgrids use fuel cells, microturbines, photovoltaics, and wind power.[36] Fuel cells produce heat and electricity quietly and efficiently at low emissions levels by using an electrochemical reaction.[37] They are highly reliable and can be powered with hydrogen, landfill gas, or other low-emission fuels.[38] They are presently extremely expensive, costing $3,000 per kilowatt, but are expected to become much more affordable once they are mass-produced.[39] Microturbines are small gas turbines that are "quiet, readily dispatchable" and relatively inexpensive.[40] They can be powered by low-emission natural gas, produce electricity for seven to ten

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29. NAVIGANT CONSULTING, *supra* note 9, at 11.

30. *Id.* at 13.

31. *Id*.

32. *Id.*

33. *Id.*

34. Robert H. Lasseter, *Microgrids and Distributed Generation*, 133 J. ENERGY ENGINEERING 144, 144 (2007).

35. *Id.*

36. RES. DYNAMICS CORP., CHARACTERIZATIONS OF MICROGRIDS IN THE UNITED STATES 6, 9 (2005), *available at* http://www.electricdistribution.ctc.com/pdfs/RDC_Microgrid_Whitepaper_1-7-05.pdf.

37. BRUCE BIEWALD ET AL., SYNAPSE ENERGY ECONOMICS, INC., PORTFOLIO MANAGEMENT: HOW TO PROCURE ELECTRICITY RESOURCES TO PROVIDE RELIABLE, LOW-COST, AND EFFICIENCY ELECTRICITY SERVICES TO ALL RETAIL CUSTOMERS, C-1 (2003), *available at* http://www.raponline.org/pubs/portfoliomanagement/synapsePMpaper.pdf.

38. *Id.*

39. *Id.*

40. *Id.*

cents per kilowatt-hour and have relatively low but growing efficiencies.[41] Photovoltaics remain very expensive, at $5,000 per kilowatt, but release no emissions and have low operation and maintenance requirements.[42] Wind turbines have seen significant technological developments recently, which have increased their reliability and efficiency while lowering their costs.[43] They cost between $1,000 and $3,000 per kilowatt, though this price is dropping.[44] Microgrids are also uniquely situated to take advantage of "cogeneration or combined cooling heat and power" (CCHP) technology.[45] CCHP, also known as cogeneration, uses a "heat recovery unit to capture heat from a combustion system's exhaust stream."[46] This excess heat, usually converted to steam or hot water, is used to heat buildings or facilities near the generation source extremely efficiently.[47]

Energy distribution and generation technologies are fast approaching the level at which the benefits described above can be readily provided to consumers.[48] However, advisors to the DOE have identified a number of regulatory and policy obstacles that will require government intervention if they are to be overcome.[49] They call for increased government investment in microgrid research and development to meet projected needs and note that many regulatory barriers still need to be addressed.[50] Discussions with energy regulators reveal other concerns about microgrid implementation that must be addressed before implementation can become more widespread. These include:

> [R]educing the customer base over which current distribution system capital investments, and various regional transmission charges, can be spread, contributing to planning ambiguity for transmission and distribution capacity expansion, requiring distribution system upgrades, providing standby power, adversely impacting the system's load profile, complicating distribution

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41. *Id.*
42. *Id.*
43. *Id.*
44. *Id.* at C-1– C-2.
45. Lasseter, *supra* note 34, at 144–46.
46. U.S. Environmental Protection Agency, Combined Heat and Power Partnership: Basic Information, http://www.epa.gov/chp/basic/index.html (last visited Apr. 15, 2010).
47. *Id.*
48. *See* King, *supra* note 14, at 55 ("There is a growing body of research that indicates that DERs are not only a reasonable investment for certain types of customers . . . , but could also provide net benefits to the area's legacy utility and its customers while improving energy use efficiency and environmental equality.") (citation omitted).
49. NAVIGANT CONSULTING, *supra* note 9, at 5.
50. *Id.*

> system fault protection and emergency repairs, and adding strain on the national gas distribution system.[51]

While not all microgrids will face these problems, regulators and field scholars stress that it is important to manage them through demand charges, tariffs, regulation, and other control approaches.[52]

II. WHILE THE COURTS HAVE LONG RECOGNIZED A GOVERNMENTAL RIGHT TO GRANT AND REGULATE NATURAL, NECESSARY MONOPOLIES IN THE POWER SECTOR, THERE HAS BEEN A SHIFT TOWARDS ALLOWING GREATER COMPETITION AMONG UTILITIES WITHIN SERVICE TERRITORIES

A. States have traditionally granted monopoly control of service territories to a distribution utility, but deregulation has begun to change this mode

As the newly established, fast-growing electric industry of the late 19th century began to consolidate in order to take advantage of economies of scale, it became necessary for the government to regulate this fast-developing monopoly system.[53] By the mid-1920s, 16 companies controlled 85% of the nation's electricity.[54] This unchecked monopoly power led to stock manipulation and shareholder abuse.[55] Between 1920 and 1935, the federal government stepped in with a number of regulations controlling power sales.[56] These new regulations of wholesale power sales, coupled with increasing state government controls on retail rate-setting, created utility service territories controlled by a sole distribution utility.[57] Service territory regulation was designed to protect and nurture these monopolies because they were deemed the most efficient, cost-effective way to deliver a product necessary for the public good.[58] This monopoly power legacy still influences the industry today.

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51. ELECTRIC POWER INDUSTRY, *supra* note 27, at 2.
52. King, *supra* note 14, at 75–79.
53. TOMAIN & CUHADY, *supra* note 4, at 265–66.
54. *Id*. at 266.
55. *See* Joseph P. Tomain, *Electricity Restructuring: A Case Study in Government Regulation*, 133 TULSA L.J. 827, 830–81 (1997) (discussing the concentration of electric monopolies from 1920 to 1935 and stating that "[t]he electric trusts, like the oil trusts before them, were susceptible to stock manipulation and shareholder abuses").
56. *Id.* at 831.
57. *See id.* at 832 (discussing the regulatory compact between the government and the electric industry).
58. *Id.* at 831–32.

Despite this historical influence, the system began to change in the 1960s and 1970s as the costs of doing business in the electric industry increased, and the market for electric power became saturated.[59] The closely regulated utilities did not have the flexibility to deal with these economic changes.[60] In response, Congress passed the Public Utility Regulatory Policies Act (PURPA), which encouraged independent power production through small power generation by independent facilities producing 80 megawatts or less.[61] This development set the stage for electric competition in the U.S. power market.[62] PURPA was considered a success that "revealed that traditional regulation had run its course."[63] New non-utility generated electricity was available, and generators were eager to enter the market and sell power at prices lower than those offered by the incumbent regulated utilities.[64]

In later years, however, market failures resulting from inadequate competition prompted regulators to reinstate regulations in some states, while leaving others unregulated.[65] While generators were eager to enter the market, the transmission infrastructure was not designed to promote competition.[66] The capacity of transmission grids is limited, creating a bottleneck that forces generators to scramble for access.[67] This is particularly problematic because storage of electricity is expensive, inadequate, inefficient, and the demand for electricity must be met on an instantaneous basis.[68] Additionally, power generation is extremely capital intensive, and power plant construction requires extensive planning, permitting, and financing, as well as careful balancing of supply and demand across many locations connected to the grid. This makes it very difficult for a generator to enter the market. Finally, energy markets are particularly susceptible to tacit collusion and manipulation, as they depend on repeated organized bidding for electricity resources.[69] This bidding

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59. *Id.* at 834.

60. *See id.* at 833–35 (discussing the regulatory failure during 1965–1996 and the impact of that failure on the electric industry).

61. TOMAIN & CUHADY, *supra* note 4, at 271.

62. *Id.* at 272.

63. *Id.* at 272–73.

64. *Id.* at 273.

65. *See generally* ELECTRICITY DEREGULATION: CHOICES AND CHALLENGES 20–23 (James M. Griffin & Steven L. Puller eds., 2005) (discussing the political economy of electricity deregulation).

66. *See* RICHARD COWART, REGULATORY ASSISTANCE PROJECT: MARKET POWER AND MARKET MONITORING – CRITICAL ISSUES FOR COMPETITIVE WHOLESALE MARKETS 1 (2003) ("The existing enterprises are large, with infrastructure designed and built to serve customers in transmission system control areas where there was no need to consider promoting competition.").

67. *Id.* at 2.

68. *Id.*

69. *See id.* ("Markets that function as a 'repeated game' are particularly subject to tacit

process can be used to promote communication and cooperation that manipulates pricing.[70] Under these conditions, even willing generators had difficulty entering the market and competing effectively.

B. While deregulation and re-regulation have had varied impacts on microgrid development in different states, a few states have recently been proactive about encouraging microgrid development

Generally, whether an entity has a legal right to build and operate a microgrid depends on whether a microgrid is defined as a public utility.[71] In 2002, researchers surveyed former and current utility commissions about "the regulatory environment that would be faced by non-utility parties that might wish to develop and run small micro-grids that contain distributed generation[.]"[72] The 2002 survey indicates that at that time most states did not permit microgrid construction.[73] While the survey sample is small, consisting of only eight states,[74] the authors maintain that this sample is representative of the United States at the time that the survey data was taken.[75] The data reveals that of eight respondents, only three felt that it would be possible to build and operate a microgrid system in the 2002 regulatory environment in their states.[76] Minnesota would permit a microgrid furnishing fewer than 25 persons with electricity, because regulatory law in the state defines a public utility as serving more than 25 persons, though the law did not specify "whether 'persons' refers to people, meters, or facilities."[77] This would allow the microgrid to "fly under the radar" as an unregulated entity. In Washington and Montana, microgrids were explicitly permitted and defined as regulated entities.[78] The public utilities commission must regulate these microgrids' rates, and their other operations are subject to commission control.[79] In all of the other states,

collusion . . . .").

70. *Id.*

71. King, *supra* note 14, at 63.

72. Hisham Zerriffi & M. Granger Morgan, *The Regulatory Environment for Small Independent Micro-Grid Companies*, 15 ELECT. J., Nov. 2002, at 52, 53.

73. *Id.*

74. *See id.* (polling utility regulators from Montana, Florida, Vermont, Minnesota, Washington, South Dakota, Alabama, and Indiana who participated in the survey).

75. *Id.* at 57.

76. *Id.* at 53.

77. *Id.*

78. *Id.* at 54.

79. *Id.*

utility commissions grant exclusive service territories to incumbent utilities, rendering microgrids illegal.[80]

Recently, however, a few states have started to actively promote microgrids through a number of different statutory approaches. The Subsections below describe active microgrid projects in these states and detail a sampling of techniques that exist under their regulatory regimes. State approaches vary, but common themes include: defining distributed generation and related distribution systems, providing long-term financial incentives to microgrid developers, removing regulatory barriers to distributed generation and related grids, and requiring incorporation of energy efficiency and renewables in microgrid projects.

1. Massachusetts

Massachusetts has been a leader in recognizing the value of microgrids in its regulations and encouraging their use throughout the state. For example, Wellesley College installed a seven-megawatt utility plant with distribution across the entire campus in 1999.[81] The campus grid is connected to the local distribution system, which it uses when the microgrid fails.[82] In the event that the local grid fails, the Wellesley microgrid "islands" or separates itself from the grid and continues to function in order to supply the Wellesley campus with power.[83] The Wellesley control system can operate individual generation engines in order to meet campus demand, but it cannot sell power back to the grid when islanded.[84]

This microgrid project, part of a comprehensive energy program, has been touted as a success by the college.[85] Wellesley combined the microgrid approach with an aggressive campaign to manage campus energy demand through building upgrades, high-efficiency designs in new construction, and comprehensive education programs aimed at changing student and faculty behavior to support efficiency.[86] Despite significant new construction, Wellesley's electricity demand has actually fallen by nearly 12% since

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80. *Id.*
81. RES. DYNAMICS CORP., *supra* note 36, at 5.
82. *Id.*
83. *Id.*
84. *Id.*
85. Wellesley College, Sustainability, http://www.wellesley.edu/AdminandPlanning/Sustainability/energyutilities.html (last visited Apr. 15, 2010).
86. *Id.*

2003.[87] In concert with this comprehensive energy management plan, the microgrid has met 100% of campus demand.[88]

Massachusetts passed multiple laws this past summer to encourage microgrid construction similar to the Wellesley project.[89] The initiatives emphasize providing financial resources for developers and breaking down regulatory barriers to distributed generation. They require the Massachusetts Department of Public Utilities to "remove any impediments to the development of efficient, low-emissions distributed generation, including combined heat and power, taking into account the need to appropriately allocate any associated costs in a fair and equitable manner."[90] The "Massachusetts Renewable Energy Trust Fund" provides funding for microgrids and distributed generation.[91] This measure, passed in August of 2008, allows trust fund managers to implement "a series of initiatives which exploit the advantages of renewable energy in a more competitive energy marketplace by promoting the increased availability, use and affordability of renewable energy . . . ."[92] The statute explicitly permits funds to be used to develop distributed generation projects, but specifies that they must rely on energy from renewable sources such as wind or solar energy, landfill gas, hydropower, and other renewables.[93] Energy from coal, oil, natural gas, and nuclear power is explicitly excluded from receiving funding, even in a distributed generation application.[94]

Massachusetts has also taken steps to mitigate uncertainty about which systems would fall under these new provisions. The new statutes specifically define "distributed generation" as "a generation facility or renewable energy facility connected directly to distribution facilities or to retail customer facilities which alleviate or avoid transmission or distribution constraints or the installation of new transmission facilities or distribution facilities."[95]

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87. *Id.*

88. RES. DYNAMICS CORP., *supra* note 36, at 4.

89. ISO NEW ENGLAND, OVERVIEW OF THE SMART GRID –POLICIES, INITIATIVE, AND NEEDS 2 (2009), *available at* http://www.iso-ne.com/pubs/whtpprs/smart_grid_report_021709_final.pdf.

90. MASS. GEN. LAWS ANN. ch. 164, § 142 (West 2008) ("For the purposes of this section, 'efficient, low-emissions' shall mean an efficiency of 60 per cent or greater on an annual basis and emissions lower than required by the department of environmental protection.").

91. MASS. GEN. LAWS ANN. ch. 40J, § 4E(f) (West 2008).

92. *Id.* § 4E(b).

93. *Id.* § 4E(f).

94. *Id*.

95. MASS. GEN. LAWS ANN. ch .164, § 1(7) (West 2008).

2. Vermont

In Vermont, Northern Power Systems (NPS) has developed a microgrid installation to supply an industrial park in Waitsfield, Vermont.[96] Construction on this microgrid system began in 2004, and NPS expects that it will be far larger and more complex than the microgrids often deployed in universities like the one used at Wellesley.[97] NPS, which is headquartered in Barre, Vermont, designs, manufactures, installs, and services power systems using renewable wind resources.[98] While it has been involved in the renewables industry, creating individual units for small-scale application for 35 years, this was NPS's first foray into microgrid construction and management.[99] NPS has support from the Vermont Department of Public Service, the DOE, and the Washington Electric Cooperative (WEC). [100] WEC is based in Montpelier and serves a wide swath of rural Vermont.[101]

The Waitsfield facility is one of the most complex and technically advanced microgrid projects in the United States. The system features multiple generation and storage devices, including both wind and solar generators, and connects to five commercial and industrial facilities as well as 12 homes within the park.[102] The system is connected to the WEC power grid.[103] It can island itself from WEC in the event of a grid failure.[104] Additionally, system managers can use the microgrid to buy and sell power from the main grid.[105] As of 2007, this ambitious project was up and running, though experts describe it as an "extremely challenging" application because of the number of "autonomous micro-generation" on the grid.[106]

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96. MIKE BARNES ET AL., *REAL-WORLD MICROGRIDS*—AN OVERVIEW, IEEE INTERNATIONAL CONFERENCE ON SYSTEMS ENGINEERING 3 (2007).

97. RES. DYNAMICS CORP., *supra* note 36, at 8–9.

98. Press Release, Northern Power Systems, Northern Power Systems Launches European Wind Business (Sept. 30, 2009).

99. RES. DYNAMICS CORP., *supra* note 36, at 9.

100. *Id.*

101. Washington Electric Cooperative, Facts, http://www.washingtonelectric.coop/pages/about.htm (last visited Feb. 12, 2010).

102. RES. DYNAMICS CORP., *supra* note 36, at 9.

103. *Id.*

104. *Id.*

105. *See* RES. DYNAMICS CORP., *supra* note 36, at 9 ("A microgrid power network is . . . capable of operating either in parallel with, or independent from, a larger electricity grid, while providing power to multiple load centers or end users."). This means that it is selling power to the grid like a traditional generation source—and that it accepts and monitors power coming in from the local WEC power station.

106. BARNES ET AL., *supra* note 96, at 3.

Acceptance of the NPS project is a significant departure from the regulatory environment that existed in Vermont only a few years ago. Michael Dworkin, Chairman of the Vermont Public Utilities Commission from 1999 to 2005, noted that retail choice was not available in Vermont during his tenure with the Commission.[107] Consequently, microgrids probably could not be operated as unregulated entities within the monopoly utility service territories that blanketed the state.[108] While legislation could be introduced allowing microgrids to operate as unregulated entities, Dworkin noted in 2002 that this appeared unlikely.[109]

However, approval of the Waitsfield grid illustrates that the legislative landscape has opened up to microgrids in the past couple of years. When asked which statutes would apply to permitting for the Waitsfield grid, Dworkin highlighted Section 109 and Section 203 of Title 30 of the Vermont Statutes Annotated.[110] According to these statutes, a microgrid comes under the jurisdiction of the Vermont Public Service Board, which is granted statutory authority over any "company engaged in the manufacture, transmission, distribution or sale of gas or electricity directly to the public or to be used ultimately by the public for lighting, heating or power . . . ."[111] Companies owning or operating generating plants with 80 megawatts or more of generating capacity must obtain a certificate of consent from the Public Service Board in order to transmit electricity from the plant.[112] Certificates of consent are granted if the Service Board "determines that the proposed transaction shall promote the general good of the state[,]" which gives the Board wide latitude to define the "general good."[113] With the approval of the NPS project, it seems that the Service Board is now open to defining microgrids as promoting the general good of the state in a manner that warrants certificate approval.

3. California

The Pleasanton Power Park exemplifies both the opportunities for, and challenges of, microgrid development in California. The project, installed in a commercial office park, was designed in 1998 and constructed in 2001.[114]

107. Zerriffi & Morgan, *supra* note 72, at 55.
108. *Id.*
109. *Id.*
110. Interview with Michael Dworkin, Dir., Vt. Inst. for Energy and the Env't, in S. Royalton, Vt. (Nov. 18, 2008).
111. VT. STAT. ANN. tit. 30, § 203 (2008).
112. *Id.* § 109.
113. *Id.* § 109 (e).
114. RES. DYNAMICS CORP., *supra* note 36, at 6.

The DOE and the California Energy Commission provided grants to help fund the project, and Intergy Solstice Group, a private firm, provided the lead on energy systems design and installation.[115] The system interconnects three photovoltaic rooftop arrays totaling over 340 kilowatts of generation capacity, one fuel cell inside one of the buildings, and a number of small microturbines within each building.[116] It also features a 100 kilowatt-hour storage unit to increase reliability of the system.[117] The office park was successfully marketed as providing maximum reliability to tenants requiring "premium power" while reducing energy costs through a combination of DG technology connected to the grid, high-efficiency retrofitting, and careful energy management.[118] Intergy Solstice noted, however, that this model could not be duplicated elsewhere unless the state laid significant regulatory groundwork to smooth over the permitting and management process.[119] The company

> noted several obstacles to development arising from the fact that there was no regulatory precedent that allowed development to progress quickly. They had to address utility standby charges, master metering, local building permits and codes, property line requirements, FERC jurisdictional requirements, and ways to obtain credit for enhanced utility grid benefits.[120]

Intergy suggested that these challenges must be addressed if microgrid development is to increase in California.[121]

Since 2001, California has started to encourage microgrid construction by trying to address the issues raised by Intergy. California statutes include general provisions requiring that regulators

> [i]dentify and undertake those actions necessary to reduce or remove constraints on the state's existing electrical transmission and distribution system, including, *but not limited to*, reconductoring of transmission lines, the addition of capacitors to increase voltage, the reinforcement of existing transmission capacity, and the installation of new transformer banks.[122]

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115. *Id.*
116. *Id.*
117. *Id.*
118. *Id.*
119. *Id.*
120. *Id.*
121. *See id.* (noting that regulatory challenges make it difficult to reproduce the project successfully).
122. CAL. PUB. UTIL. CODE § 379.5(a)(1) (West 2004) (emphasis added).

"Necessary actions" can include increased distributed generation made available through microgrid construction to limit strain on the grid. Specifically, the state provides that:

> The State Energy Resources Conservation and Development Commission shall expand programs to promote clean distributed generation technologies neither owned nor controlled by electrical corporations. . . . [T]he incentives that the commission shall develop pursuant to this section shall address existing barriers to the increased use of these technologies, including, but not limited to, incentives to help reduce the initial system purchase price, develop low-cost financing mechanisms, offset interconnection fees charged by electrical corporations, and streamline the utility interconnection process by reducing administrative delay.[123]

The support that this legislation provides for microgrid development in the state of California is manifold. Reinforcing and strengthening existing grid infrastructure reduces the physical constraints that limit microgrid access. Financial support makes microgrids more economically viable. Finally, reducing administrative burdens during the interconnection process not only reduces the man hours required to get a project running, it also alleviates concerns that a project might become stymied by bureaucratic issues and ultimately become a wasted investment.

The state has tried to shape these general provisions with specific definitions and requirements aimed directly at microgrids or the distributed generation technologies that they promote. The California Code defines "'ultraclean low-emission distributed generation'" as distributed generation that "[p]roduces zero emissions during its operation or produces emissions during its operation that are equal to or less than the 2007 State Air Resources Board emission limits for distributed generation . . . ."[124] The statute provides that "[i]n establishing rates and fees, the commission may consider energy efficiency and emissions performance to encourage early compliance with air quality standards established by the State Air Resources Board for ultraclean and low-emission distributed generation."[125] California also mandates that "[i]ncentives for load control and distributed generation be paid for enhancing reliability."[126] The Commission, in consultation with the State Energy Resources Conservation and

123. CAL. PUB. UTIL. CODE § 739.10(8)(A) (West 2001).
124. CAL. PUB. UTIL. CODE § 353.2 (West 2006).
125. *Id.*
126. CAL. PUB. UTIL. CODE § 379.5(b)(6) (West 2004).

Development Commission, shall administer "[d]ifferential incentives for renewable or super clean distributed generation resources."[127] This creates more certainty for potential developers by defining exactly what kind of microgrid applications would qualify for state support and what kind of support those applications would receive.

III. EXISTING STATUTES AND THE RECOMMENDATIONS OF REGULATORS, MICROGRID OWNERS, AND MANAGERS PROVIDE GUIDEPOSTS FOR AN OPTIMAL REGULATORY SCHEME FOR MICROGRIDS

A. Insights of policy-makers and microgrid managers regarding the optimal conditions for microgrid development

Surveys of policy-makers and those active in the microgrid field, as well as the research of academics, reveal a number of critical points that should be present in utility regulation in order to allow microgrids to flourish. These recommendations track the focal points of microgrid legislation in the states profiled above. Many industry experts, for example, encourage providing incentives for microgrid development similar to those available in Massachusetts and California. Navigant Consulting, a company retained by the DOE to advise it on the promotion of microgrids, argues that regulators should fairly compensate utilities for the services they provide and the investments in DG and microgrid technologies that they have made.[128] Navigant also suggests that policy should "[p]rovide transparent compensation for environmental, system reliability, and homeland security benefits."[129] Engineers at the Carnegie Mellon Electric Power Industry Center (Carnegie) suggested that regulators incorporate land use and environmental requirements into microgrid controls.[130] They note that in most cases, existing zoning laws and air pollution requirements should maintain sufficient environmental standards for microgrids.[131] Regulators should ensure that this is the case, however, and fill in any gaps in the requirements as necessary.

Many experts have also stressed the need to clearly define capacity, generation, and other characteristics of microgrids in statutory language. For example, in a series of surveys, state utility regulators suggested that

127. *Id.* § 379.5(b)(7).

128. NAVIGANT CONSULTING, *supra* note 9, at 8.

129. *Id.*

130. *See* ELECTRIC POWER INDUSTRY, *supra* note 27, at 7 (discussing prudent regulation of microgrids through local zoning ordinances and state pollution laws).

131. *Id.*

laws would have to specify limits on the amount of generation capacity installed and the number of customers each microgrid can serve.[132] Guidance for regulators provided by engineers at Carnegie also encourages regulators to explicitly specify the characteristics required for an electric power system to qualify as a microgrid.[133] They caution that "[s]tate law[s] should not specify the number or type of generators that a micro-grid system can contain because such a restriction would constrain technical innovation and might prevent the micro-grid market from developing."[134] Instead, they recommend that regulators should define a microgrid as "more than one legally distinct entity served with electric power; and one or more independent sources of electric power generation and/or storage."[135] They also recommend size limitations, suggesting the maximum number of customers or the maximum grid capacity as a limiting factor.[136] This will prevent microgrids from growing into traditional utilities over time. They caution, however, that placing these limits too low may make microgrid operations less economically viable.[137]

Maintaining high standards of service and quality through consumer protection laws was also a major theme of the guidance for regulators provided by the engineers at Carnegie. State utility regulators suggest that laws should provide an "opt-out option" for customers so that any unregulated microgrids cannot "trap" them in a service contract.[138] Other regulators also argue that consumer protection issues might be worth addressing in a specific statute. In Michigan, for example, the Public Utilities Commission requires electric suppliers to demonstrate mechanisms for meeting electric quality standards, providing consumption and reliability data to consumers and the state, resolving customer disputes, and performing other services.[139] Other states might adopt a similar approach.[140]

Additionally, removing economic and regulatory barriers to grid development is strongly encouraged. Navigant recommends that utility commissioners "[r]emove barriers to utility deployment of DER . . . ."[141] Carnegie engineers argue that states should also address the fact that legacy utilities have locked out distributed generation by "gold plating"

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132. Zerriffi & Morgan, *supra* note 72, at 57.
133. ELECTRIC POWER INDUSTRY, *supra* note 27, at 3.
134. *Id.* at 3.
135. *Id.* at 2.
136. *Id.*
137. *Id.* at 2–3.
138. Zerriffi & Morgan, *supra* note 72, at 57.
139. ELECTRIC POWER INDUSTRY, *supra* note 27, at 6.
140. *Id.*
141. NAVIGANT CONSULTING, *supra* note 9 at 22. DERs are distributed energy systems. *Id.*

interconnection standards, or manipulating tariffs to make it prohibitively expensive to gain access to the grid.[142] In order to mitigate this, the Public Utilities Commission should establish approved rates for interconnection that require legacy utilities to pay half the cost of interconnection.[143] Navigant encourages national adoption of interconnection standards in order to streamline interconnection management.[144]

Managing the interactions between an incumbent distribution utility and a microgrid will probably be a critical part of smoothing the market entry process for microgrids. One such technique is to carefully design a "bi-directional tariff."[145] In the electric utility context, a "tariff" refers to the "official rates and terms of service" that public utilities commissions allow utilities to implement.[146] According to the DOE, "[u]tility tariffs and pricing structures can have a significant impact on the economic viability of distributed energy systems, especially the type of metering arrangements and charges for standby power that are imposed on the self-generator."[147] Tariffs can include details on everything from descriptions of service and limitations on rates to service contracts to rules governing discontinuance and restoration of service.[148] They can also include charges to recover stranded investments in electricity infrastructure.

Stranded costs are a major concern when innovations occur in the electric industry. According to the DOE,

> [s]tranded investments are investments in power plants or demand-side-management measures that become uneconomic due to increased competition in the electric power market . . . As a result, the power plant owner may have to close the plant, even though the capital and financing costs of building the plant have not been recovered through prior sales of electricity from the plant.[149]

These stranded costs become an issue "when lower electricity prices resulting from competition reduce the ability of utilities to recover expenses

142. ELECTRIC POWER INDUSTRY, *supra* note 27, at 6.

143. *Id.*

144. NAVIGANT CONSULTING, *supra* note 9, at 16.

145. *See generally* Zerriffi & Morgan, *supra* note 72, at 57 (explaining the possible conflicts between incumbents and new microgrids).

146. California Public Utilities Commission, Utility Tariff Information, http://www.cpuc.ca.gov/puc/energy/electric+rates/utilitytarriffs/ (last visited Feb.10, 2010).

147. Department of Energy, Utility Tariffs and Pricing Issues [hereinafter Utility Tariffs], *available at* www.eere.energy.gov/de/utility_tariffs_pricing.html.

148. *See, e.g.*, Pacific Gas and Electric, Tariff Book, http://www.pge.com/tariffs/ER.SHTM#ER (last visited Apr. 14, 2010) (exemplifying the contents of a tariff).

149. Utility Tariffs, *supra* note 147.

incurred on behalf of their customers under earlier regulatory arrangements. There is uncertainty about who should pay for these stranded costs—utility shareholders, ratepayers, or both."[150] Legacy utilities are likely to vigorously oppose any change in regulations that creates opportunities for competition within their service territory.[151] Public utilities commissions might smooth this process by including statutory provisions that ensure that legacy utilities could recover stranded costs.

Carnegie engineers note that managing interactions between legacy utilities and microgrids should be approached differently in states where the electric markets have been deregulated, versus states where they have not.[152] In deregulated or restructured markets, they argue that microgrids should be able to buy and sell power on the market wherever the microgrid exists.[153] In states that have not deregulated, they maintain that the regulatory environment must have enough flexibility to allow microgrid operators and legacy utility operators "to reach contractual agreements that supersede the basic rate set by the [public utility commission]."[154] While this would allow legacy utilities to create incentives for microgrids in order to ease their own production burdens, any agreements should be carefully and publicly reviewed by the public utility commission to prevent abuse.[155] Regardless of the state, microgrid firms should be required to give six to nine months of advanced notice of their construction plans to the public utility commission. Those involved in microgrid projects feel this time frame strikes a balance between giving adequate warning to existing utilities and encouraging the growth of microgrid markets.[156] Microgrid firms should also be required to pay the same public benefits charges as legacy utility companies.[157]

Finally, though not yet extensively addressed in state legislation, Carnegie engineers argue that technical barriers must be addressed along with economic and regulatory obstacles to microgrid development. They state that regulators will have to manage interconnection and power quality

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150. *Id.*

151. *See* Zerriffi & Morgan, *supra* note 72, at 56 (stating that the respondents in the study "felt that existing utilities would oppose any legislation—with more than one stating that such opposition would be very 'vigorous'").

152. ELECTRIC POWER INDUSTRY, *supra* note 27, at 3.

153. *Id.* at 4.

154. *Id.*

155. *See id.* at 5 (recommending notification requirements for microgrids so that utilities can review "capacity, location, number of customers expected on the microgrid, and and estimate of the power sale and purchase transactions anticipated with, or through, the legacy distribution system").

156. *See id.* (stating that "[i]f it were longer, the notification requirement could significantly inhibit the growth of micro-grid markets.").

157. *Id.*

standards if the technical requirements for microgrid implementation are to be met.[158] In order to protect line workers in the event of an outage, regulators should include emergency disconnection standards to prevent the formation of electrified "islands" in a downed grid that might unexpectedly injure workers.[159]

B. Recommendations for regulators: suggestions for an ideal statute, based on the insights of those in the field

This analysis of regulatory barriers to microgrid construction reveals a consensus about a number of key points that must be addressed in an effective statute designed to promote microgrids. Regulators must clearly define microgrids and explicitly remove all existing regulatory, technical, and economic barriers to microgrid market entry. Regulators must also maintain high microgrid service and safety standards. Finally, regulators should design financial incentives for microgrids, including benefits for renewable technology and energy efficiency programs. This Section will detail how those goals should be achieved.

First, a statute promoting microgrids should clearly define a microgrid. Some states have already taken this approach with a general definition. Massachusetts, for example, describes microgrids in its statutory language, but does not use quantitative terms.[160] California also includes definitions in its relevant statutory language, but while it limits the emissions that sources connected to microgrids can create, it does not limit the size and capacity of the microgrids themselves.[161] Regulators should adopt the practice of explicitly defining the maximum grid capacity, or number of customers that a microgrid may serve. They should be careful, however, to avoid restricting the size of the grid so aggressively that their actions limit the economic viability of the microgrid system. This will strike a balance between allowing microgrids to develop into traditional utilities, depriving the grid of the unique benefits that microgrids provide, and over-regulating microgrids in a way that limits their viability.

Second, regulators should create a provision requiring the removal of obstacles to microgrid ownership and management. Again, the case studies illustrate that several states have already attempted this. However, they have generally done so under a broad, blanket provision that does not specify

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158. *Id.*

159. *Id.*

160. *See* MASS. GEN. LAWS ANN. ch. 164, § 1(7) (West 2008) (describing "distributed generation").

161. CAL. PUB. UTIL. CODE § 353.2 (West 2006).

how this should be accomplished.[162] To improve this approach, regulators should explicitly state that private ownership of transmission lines is permissible. Additionally, they should manage interconnection to ensure that the administrative process is streamlined and that costs are limited. This will help microgrid developers overcome the "gold plating" obstacle to interconnection that makes it prohibitively expensive for them to connect to the larger grid. It will also help to overcome some of the obstacles that Intergy faced in California by providing a clear template for the interconnection part of the permitting process.

Third, regulators should be careful to protect the public when allowing microgrids to compete in the electricity market. Statutory language should protect consumers by requiring "opt-out provisions" in contracts for service. This will ensure that buyers are not forced to accept sub-standard service if microgrid programs fall below par. Regulators should also require performance reviews of microgrid companies. Reviews should require demonstrations of quality standard attainment, collection of reliability data, and performance of other important functions. Regulators should also protect line crews by implementing emergency disconnection standards.

Finally, regulators should be mindful of how a statute will impact the financial incentives for developing microgrids. Statutory provisions should be made that not only offer incentives for microgrid developers, but also ensure that legacy utilities will have some means of recovering stranded costs once microgrids enter into the market. Several states already maintain funds specifically designed to promote the development and implementation of microgrid systems. States could adopt the model of the Massachusetts Renewable Energy Trust Fund, providing special benefits to microgrids that advance renewable technologies. Alternatively, or in addition to the design of a fund, states could adopt the Californian model of allowing public utility commissions to adjust rates to recognize the environmental and reliability benefits that microgrids provide. On the legacy utility side, public utilities should allow for the recovery of stranded investments in utility infrastructure that become unprofitable due to competition from microgrid companies. With this approach, regulators can make microgrids financially attractive to both owners and consumers while easing the blow of increased competition for legacy utilities.

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162. *See supra* Part II.

CONCLUSION

Legislation enabling microgrid construction "could unleash a wave of technological and business innovation[] . . . ."[163] This wave of innovation could have significant benefits for American society. It could reduce the need for costly new generation capacity and expansion of the transmission and distribution system while simultaneously relieving stress on the existing over-taxed distribution system. It could promote competition with legacy utilities, driving innovation and encouraging lower rates. It could also provide cleaner, more reliable power to consumers while stimulating the market for small-scale generation equipment and services, local power architecture, and demand side management services. These demand side management services would help microgrid users manage their consumption in order to stay within the limits of the grid.[164]

At present, there are obstacles standing in the way of this "wave of innovation." The regulatory history of promoting utility monopolies makes microgrids illegal in many states. As the Intergy case study from California demonstrates, launching a microgrid project can be difficult even in states where such applications are legal.[165] No precedent exists for navigating the permitting procedure, forcing microgrid owners to go through an ad hoc process involving significant commitments of time and capital without any certainty regarding the outcome. Additionally, there is pressure from legacy utilities to lock microgrids out of the market. They have no incentive to allow increased competition within their service territories, especially if they cannot recover "stranded" costs. These issues make it difficult for individuals or firms to construct microgrids.

If regulators take steps to mitigate these difficulties, it could have significant benefits for consumers and for the environment. They should draft statutory language that removes obstacles to microgrid ownership and operation while protecting consumers and the public. Taking these steps to open the electric sector to microgrids will improve the reliability of the grid as a whole, promote the use of renewable energy technologies, and ultimately lower energy costs due to avoided new construction. In the long term, making these changes would allow private-sector stakeholders to harness opportunities to produce and distribute electricity more efficiently. This will turn the "zero sum game" of transitioning to a new energy

163. ELECTRIC POWER INDUSTRY, *supra* note 27, at 1.

164. *Id.*

165. *See generally* RES. DYNAMICS CORP., *supra* note 36, at 6 (explaining that the pleasant park project was a unique fit for a regulatory scheme otherwise resistant to the implementation of microgrid projects).

economy into a profitable endeavor with benefits for the environment, the economy, and American consumers.

—*Kari Twaite*[*†]

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* J.D. candidate 2011, Vermont Law School; M.E.M. candidate 2011, Yale School of Forestry and Environmental Studies; B.A., *cum laude*, 2006, Bowdoin College.

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