FIGHTING ENERGY SPRAWL WITH MICROGRIDS

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ABSTRACT

Energy sprawl—the phenomenon of ever-increasing consumption of land, particularly in rural areas, required to site energy generation facilities—is a real and growing problem that exceeds the capabilities of both state and local governments. Solving it will require a multi-faceted approach from all levels of government.

One significant component of the solution must be the alternative energy microgrid—that is, small-scale distributed generation between neighbors for energy derived from sources such as solar collectors, wind power systems, microturbines, geothermal wells, and fuel cells. Microgrids are attractive from a public policy perspective. They decentralize energy production, reducing the need for massive transmission lines and large centralized plants. They allow property owners to achieve economies of scale by spreading the costs and the risk of installation and maintenance among many parties. They provide cleaner alternatives to conventional energy methods of production. And they improve system efficiencies by reducing the amount of energy lost during transmission across long distances to end users.

Despite their benefits, state laws prohibit or severely limit the viability of microgrids, while neighbors may object to living near them. We must determine how to overcome these barriers in regulating and siting microgrids. In furtherance of that goal, this Article first explains the problem of energy sprawl and the advantages of the microgrid. It then explains three types of barriers to microgrids: regulatory barriers, political barriers, and economic barriers. The Article focuses on the issues of regulation and siting and concludes with two recommendations. First Congress require states to consider a model standard for microgrids, just as it has required states to consider model standards for other kinds of utility law. Ideally, this standard would legalize and facilitate small-scale energy sharing by using the rules of governance and exclusion which best suit a semicommons. Second, states should provide guidance to localities with respect to siting and permitting microgrid projects.

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Energy sprawl—the phenomenon of the ever-increasing consumption of land,[1] particularly in rural areas, required to site energy generation facilities—is a real and growing problem. Over the next ten years, significant investment in energy infrastructure will lead to widespread fragmentation and damage to natural ecosystems and wildlife and bird habitats.[2] Ten years after that, at least sixty-seven million acres of land will have been developed for energy projects.[3] By 2050, demand for electricity is expected to double, requiring the use of even more land.[4] Curbing energy sprawl exceeds the capabilities of local governments, and even states, as sprawl by definition presents complex cross-jurisdictional questions.

With demand for energy showing no signs of abating, slowing energy sprawl will require a multi-faceted approach by all levels of government. One key component of this approach must be alternative energy microgrids—that is, small-scale, low-voltage distributed generation[5] between neighbors for energy derived from

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[1] This Article focuses on land, but energy can extend to waters, too. In 2009, the Obama administration announced a new policy opening federal waters for alternative energy projects, with potentially profound negative impacts on the environment. *See* President Barack Obama, Remarks by the President on Clean Energy, Newton, Iowa, Apr. 22, 2009 *available at http://www.whitehouse.gov/the_press_office/Remarks-by-the-President-in-Newton-IA/* (announcing this policy).

[2] Jessica B. Wilkinson & Robert Bendick, *The Next Generation of Mitigation: Advancing Conservation through Landscape-Level Mitigation Planning*, 40 ENVTL. L. REP. NEWS & ANALYSIS 10023, 10023 (2010) (predicting "widespread fragmentation of and damage to the natural systems that provide essential human benefits and habitat for plant and animal species").

[3] Darci Palmquist, New Energy Production and Nature: What Will the Impacts Be?, The Nature Conservancy, Aug. 26, 2009, *at* http://blog.nature.org/2009/08/new-energy-production-nature-impacts-energy-sprawl-renewable-rob-mcdonald/ (interviewing the author of the Nature Conservancy report).

[4] U.S. DEP'T OF ENERGY, THE SMART GRID: AN INTRODUCTION 18 & 20 (__), *available at* http://www.oe.energy.gov/DocumentsandMedia/DOE_SG_Book_Single_Pages(1).pdf (hereinafter "THE SMART GRID").

[5] The term "distributed generation" refers to the production of electricity by a small-scale source located at or very near the end users it serves. *See also* U.S. Dep't of Energy Energy Info. Admin, A-Z Topics (2009), *at* http://www.eia.doe.gov/a-z_index/Energya-z_d.html (last visited Feb. 12, 2010) (defining "distributed generator" as a "generator that is located close to the particular load that it is intended to serve"); THE SMART GRID, *supra* note 4, at 12 (defining "distributed generation" as "the use of small-scale power generation technologies located close to the load being served, capable of

sources such as solar collectors, wind power systems, microturbines, geothermal wells, and fuel cells, which have minimal negative impact on the environment.[6] Our current legal regime, and state laws in particular, prohibit or severely limit such arrangements, thereby facilitating energy sprawl while thwarting investment in alternative energy resources. As a result, only a handful of microgrid projects have been built across the country.[7]

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lowering costs, improving reliability, reducing emissions and expanding energy options"); CA. ENERGY COMM'N PUB. INTEREST ENERGY RESEARCH, DISTRIBUTED GENERATION COSTS AND BENEFITS ISSUE PAPER 5 (2004), *available at* http://www.energy.ca.gov/papers/2004-08-30_RAWSON.PDF (stating, "[d]istributed generation is electricity production that is on-site or close to the load center and is interconnected to the distribution system").

[6] *See also* ROBERT LASSETER ET AL, CALIF. ENERGY COMM'N, INTEGRATION OF DISTRIBUTED ENERGY RESOURCES: THE CERTS MICROGRID CONCEPT 26 (2002), *available at* http://certs.lbl.gov/pdf/50829.pdf (defining the microgrid as "a semiautonomous grouping of generating sources and enduse sinks that are placed and operated for the benefit of its member customer(s)") (hereinafter "THE CERTS MICROGRID CONCEPT"); Douglas E. King, Electric Power Microgrids: Opportunities and Challenges for an Emerging Distributed Energy Architecture (Ph.D. Thesis), May 2006, at 3, *available at* http://wpweb2.tepper.cmu.edu/ceic/pdfs_other/Doug_King_PhD_Thesis_2006.pdf (hereinafter "King Thesis") (defining the microgrid as "a small group of customers, interconnected at low voltages on a local power grid with a single point of interconnection with the area electric power system"); Thomas E. Hoff et al, Distributed Generation and Micro-Grids, Sept. 1997, at 2, *available at* http://www.clean-power.com/research/microgrids/MicroGrids.pdf (defining the microgrid as "an electrically isolated set of power generator that supply all of the demand of a group of customers"); F. Katiraei & M.R. Iravani, Transients of a Micro-Grid System with Multiple Distributed Energy Resources, June 2005, at 1, *available at* http://www.ipst.org/TechPapers/2005/IPST05_Paper080.pdf (defining the microgrid as "a portion of a power system which includes one or more DG [distributed generation] units capable of operating either in parallel with or independent from a large utility grid, while providing continuous power to multiple loads and end users").

[7] *See* Press Release, Secretary Chu Announces More Than $20.5 Million for Community Renewable Energy Deployment Projects, Jan. 21, 2010, *available at* http://www1.eere.energy.gov/recovery/news_detail.html?news_id=15759 (describing a microgrid project for the Forest County Potawatomi Tribe that includes a biogas digester, wind turbines, solar panels, and a biomass combined heat and power facility and a University of California at Davis project that includes biogas, a fuel cell, and a storage battery); Kerry A. Dolan, *Thinking Small About the Grid*, FORBES, Mar. 10, 2009, *available at* http://www.forbes.com/2009/03/10/microgrid-electricity-cleantech-technology-breakthroughs-microgrid.html (noting two Wal-Mart microgrids in Colorado and Texas, a demonstration microgrid installed by the Sacramento Municipal Utility District, and a microgrid backup power system at the Santa Rita Jail); Jesse Berst, *Macro Trends Point to Microgrids*, SMARTGRIDNEWS.COM, Nov. 28, 2006, *at* http://www.smartgridnews.com/artman/publish/article_182.html (last visited Feb. 12, 2010) (identifying a CERTS facility, a subsidiary of a Michigan-based utility offering to build microgrids for commercial and industrial customers, a prototype microgrid at a Vermont commercial/industrial park, two Wal-Mart microgrids, and a demonstration project at Sandia National

Several of these projects have been publicly called microgrids but only serve one customer, so they fall outside of the definition of microgrids used by this Article.

Consider, for example, a homeowner with a solar panel installation that produces more electricity than she uses. Currently, if she can do anything at all with the excess electricity, she can only sell it back to the grid under state rules governing net metering.[8] This electricity will get redistributed through the central transmission facility to other end users, becoming less efficient the farther it travels. Under the laws of many states, the homeowner cannot enter into an agreement with her neighbor wherein the neighbor buys the excess power, lest she be considered to be a public utility[9] and therefore be regulated more heavily than would be warranted given the scale of her output.

Consider also the situation in which a group of neighbors engages in a debate as to whether to install a wind turbine in a vacant lot that the city has given to them for redevelopment. From the city's perspective, a turbine would lessen the load on the local utility, which would reduce the number of unsightly transmission lines cutting through town. But in many jurisdictions, these neighbors can divide the cost of installing the turbine but cannot pay for their later energy use without violating public utility laws. The likelihood that either the neighbors invest in the turbine, or that the homeowner invests in a solar panel whose output exceeds her basic needs, is slim. The cost of alternative energy has decreased in recent years, but not enough to make recouping ongoing costs unnecessary for private parties.

Although current state laws prohibit or severely limit alternative energy microgrids, such arrangements are attractive from a public policy perspective. They decentralize energy production, reducing the need for nationwide transmission lines and large-scale centralized plants. They allow property owners to achieve economies of scale by spreading the costs and the risk of installation and maintenance among many parties. They provide cleaner alternatives to conventional energy methods of production.

Laboratories); Galvin Electricity Initiative, Perfect Power at the Illinois Institute of Technology, *at* http://galvinpower.org/projects/perfect-power-illinois-institute-technology (last visited Feb. 12, 2010) (describing the microgrid "that will not fail the end user" at the Illinois Institute of Technology).

[8] Eight states have not allowed for net metering. LAUREL VARNADO & MICHAEL SHEEHAN, NORTH CAROLINA SOLAR CENTER & INTERSTATE RENEWABLE ENERGY COUNCIL, CONNECTING TO THE GRID 11 (2009), *available at* http://www.irecusa.org/fileadmin/user_upload/ConnectDocs/Connecting_to_the_Grid_Guide_6th_edition-1.pdf (identifying the forty-two states that currently authorize net metering).

[9] Note that the term "utility" or "public utility" in this Article encompasses only electric utilities.

And they improve system efficiencies by reducing the amount of energy lost during transmission across long distances to end users. If we agree that alternative energy microgrids are a good idea, then we must then determine how to construct legal regimes that facilitate them. In furtherance of that goal, this Article proceeds as follows.

Part I sets the stage for the rest of the Article. It begins by describing the phenomenon of energy sprawl, focusing on the role of the Nature Conservancy in framing the debate. It then identifies several points of contention with the energy sprawl concept, as identified by environmentalists, politicians, and other advocates. It concludes by acknowledging that although the energy sprawl phenomenon may be difficult to accurately measure or predict, a problem exists. A uniform approach to microgrids would be part of a multi-faceted solution.

Part II articulates the alternative energy microgrid option. It first briefly defines the microgrid and several related concepts. It then analyzes how small-scale distributed generation advances national goals with respect to energy security, energy independence, and sustainable communities.

Part III identifies barriers to the microgrid in both state and local law, focusing on the lack of coordination between various levels of government. Inconsistent, unclear, and outright hostile laws prevent users from implementing microgrids. Political considerations—most significantly the opposition of public utilities that control most of our existing energy infrastructure, and neighbors who can work through local governments to halt microgrid projects—also serve as barriers. Finally, economic factors, including subsidies of traditional energy infrastructure, work to promote energy sprawl, while thwarting the microgrid.

After concluding that the key barriers to microgrids relate to regulation and siting—both areas controlled by states—Part IV recommends two possible paths forward. First, it recommends that Congress tackle energy sprawl by requiring the states to "consider" model regulations for microgrids. The consideration requirement has encouraged states to modify their laws to provide nationally recognized interconnection standards, and I believe upon review states would find microgrids to be compelling means to meet their own alternative energy use goals. Second, it recommends that states provide guidance to localities with respect to siting and permitting microgrid projects. This guidance can be issued without infringing on localities' core autonomy in regulating land use.

Ultimately, this Article does not aim to halt alternative energy; nor does it advocate that policymakers focus solely on land use in determining whether energy projects are allowed to proceed.

Rather, it attempts to introduce one possible solution to curbing energy sprawl—that is, deploying small-scale distributed generation in places where infrastructure already exists.

I. Energy Sprawl

Although the Nature Conservancy coined the term "energy sprawl" in 2009, the phenomenon has an intuitive explanation. Simply put, energy sprawl refers to the land required to produce and move energy, measured in acres per total quantity of energy production. This Part defines energy sprawl, including jurisdictional issues that affect it. It also assesses the recent debate over the Nature Conservancy's report.

A. The Phenomenon

When Americans think of sprawl, they typically think of urban sprawl: the unplanned, and often unsightly, expansion of human development into previously undeveloped, rural areas. Urban sprawl, as its name suggests, develops in roughly concentric circles around cities. In some cases, urban sprawl is contained within city limits. In other cases, it crosses urban growth boundaries, into other counties, or even into unincorporated areas. When urban sprawl warrants government attention, interested jurisdictions often include a city and a county government or neighboring city governments. At times, state legislatures weigh in to influence land use policies, but by and large regulating urban sprawl is a local government function.

Like urban sprawl, energy sprawl involves expansion into undeveloped areas. Energy sprawl, however, is linear, not concentric. Traditional energy infrastructure, which takes the form of generating facilities and distribution centers connected by transmission lines, looks like a web in maps.[10] Another difference from urban sprawl is that energy sprawl does not necessarily follow existing settlement patterns. In fact, some of the largest energy generating facilities may be found in some of the most underpopulated places in the country. Builders of such facilities no doubt find it easier to locate in places far outside urban boundaries, where fewer people would object and where development would be less obstructed. In such areas, only counties or states have jurisdiction over siting.

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[10] *See* National Public Radio, Visualizing the U.S. Electric Grid, *at* http://www.npr.org/templates/story/story.php?storyId=110997398 (offering a comprehensive, interactive map showing energy infrastructure across the country).

While extra-urban siting may be attractive initially, it has significant negative long-term impacts. In 2009, the Nature Conservancy's "Energy Sprawl or Energy Efficiency" report focused on one of these negative impacts: the reach, in purely spatial terms, of different methods of production. The environmental nonprofit estimated that at least 206,000 square kilometers—an area larger than the state of Nebraska—will be impacted by energy development over the next twenty years, if Americans do not substantially increase energy efficiency.[11] It predicted that energy will shift from fossil fuels to methods that may require greater amounts of land than fossil fuels require.[12]

According to the calculations of the Nature Conservancy, among the least land-intensive methods of production are nuclear power, using about two square kilometers to produce a terawatt-hour annually and geothermal, using an average of seven and a half square kilometers to produce the same amount of energy.[13] Biofuels and biomass, at around three hundred and fifty and five hundred and fifty square kilometers respectively, are among the most land-intensive.[14] Somewhere in the middle are coal, at ten; solar thermal, at fifteen; natural gas, at nineteen; solar photovoltaic, at thirty-seven; petroleum at forty-five; hydropower at fifty-four; and wind at seventy-two square kilometers per annual terawatt-hour.[15] The report estimates that the land use figures for geothermal, natural gas, and wind production can be divided into direct disturbance of about five percent and indirect disturbance, involving disruptions of larger ecosystems, habitats, and wildlife activity, for the remaining ninety-five percent.[16]

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[11] ROBERT I. MCDONALD ET AL, THE NATURE CONSERVANCY, ENERGY SPRAWL OR ENERGY EFFICIENCY: CLIMATE POLICY IMPACTS ON NATURAL HABITAT FOR THE UNITED STATES OF AMERICA 2 (2009), *available at* http://www.nature.org/wherewework/northamerica/states/northcarolina/files/tnc_energy_sprawl.pdf.
[12] *Id.* at 5.
[13] *Id.* at 3.
[14] *Id.* at 21.
[15] *Id.* Note that the figures in the text are rounded to the nearest integer.
[16] *Id.* at 4 (explaining that "production techniques that involve wells like geothermal, natural gas, and petroleum have about 5% of their impact area affected by direct clearing while 95% of their impact area is from fragmenting habitats and species avoidance behavior. Wind turbines have a similar figure of about 3-5% of their impact area affected by direct clearing while 95-97% of their impact area is from fragmenting habitats, species avoidance behavior, and issues of bird and bat mortality."). The American Wind Energy Association has confirmed that for every megawatt of power, sixty acres of land are needed, although only five percent of needed land area is occupied by the actual turbine. American Wind Energy Association, Resources, *available at* http://www.awea.org/faq/wwt_environment.html#What%20are%20wind%20powers%20other%20environmental%20impacts (last visited Feb. 12, 2010).

To put this analysis in more concrete terms, take an example of one project using a somewhat land-intensive energy production method, wind farming. The largest wind farm in the world opened in October 2009, occupying one hundred thousand acres (or 405 square kilometers) in sparsely populated West Texas.[17] The farm has 627 turbines, with each turbine taking up on average about 160 acres.[18] It generates 781.5 megawatts (or 6.8 terawatt-hours, using a conversion of 114 megawatts per 1 terawatt-hour) and powers 265,000 homes.[19] For every megawatt generated, the farm uses about 128 acres of land (100,000 divided by 781.5 megawatts). Interestingly, this figure represents more than double the estimated acreage required to produce a megawatt—60 acres—by the American Wind Energy Association.[20] Converted into the units of measurement used by the Nature Conservancy report, in order to produce one terawatt-hour of energy, the farm requires approximately 60 square kilometers of land (405 square kilometers divided by 6.8 terawatt-hours). Although the number of acres used by this particular wind farm, 60, is fewer than the 72 square kilometers estimated by the authors of the Nature Conservancy report, the Nature Conservancy report estimate seems reasonable, given this farm's exceptional size.

Taking this example a step further reveals how this wind farm contributes to energy sprawl. To be sure, the turbines occupy a significant amount of land themselves. Using the industry standard estimate that five percent of the land in a wind farm is actually used for equipment,[21] 5,000 acres of land of the Texas wind farm is likely directly occupied and thus disturbed by the generating equipment (turbines). It is unclear whether this five percent estimate includes the blasting, bulldozing, and digging required to locate the deep concrete foundations needed to support the massive steel turbines, or if it includes the roads, substations, and other facilities that support the turbines. Assuming that it does, the surface of the remaining 95,000 acres of the wind farm remains open. This open land may suffer from indirect effects from the construction, operation, and maintenance of the turbines. Such activities also alter delicate ecologies (underground and

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[17] Elizabeth Souder, *World's Largest Wind Farms Opens in West Texas*, DALLAS MORNING NEWS, Oct. 1, 2009, *available at* http://www.dallasnews.com/sharedcontent/dws/bus/stories/DN-wind_01bus.State.Edition1.ddb4af.html.

[18] *Id*.

[19] *Id.*

[20] *See* American Wind Energy Association, *supra* note 16.

[21] *Id*.

aboveground), as well as landscape vistas.[22] Giving new meaning to the term "climate change," studies have shown that wind farms hinder not only weather forecasting,[23] but also the natural patterns of weather itself.[24]

Birds and other wildlife may be as directly threatened than their habitat. In California, one wind farm killed so many birds—tens of thousands, including more than a thousand protected golden eagles—that citizens brought its owners to court.[25] Responding to the alleged facts behind the California case, the American Wind Energy Association stated that "detailed studies, and monitoring following construction, at other wind development areas indicate that this is a site-specific issue that will not be a problem at most potential wind sites."[26] Even if birds and other wildlife are only minimally threatened by newer wind technologies, critics of wind energy believe that large-scale wind developments have a devastating effect on the immediate environment.

Beyond the 100,000 acres, large transmission lines must be built to get power to the 265,000 homes to be served by the wind farm. These lines take years to create, given the need to coordinate with private landowners, and are extremely expensive. Moreover, power lost in transmission is roughly ten percent.[27] Accordingly, energy sprawl costs space, money and energy itself.

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[22] *See*, *e.g.*, Adam M. Dinnell & Adam J. Russ, *The Legal Hurdles to Developing Wind Power as an Alternative Energy Source in the United States: Creative and Comparative Solutions*, 27 NW. J. INT'L L. & BUS. 535, 538 (2007) (stating that critics "view this supposed environmental savior as a man-made plague on local landscapes and communities, fragmenting habitats, and causing irreparable ecological damage").

[23] *See* William Kates, *Wind Farms Interfering with Weather Radar in N.Y.*, U.S.A. TODAY, Oct. 13, 2009, *available at* http://www.usatoday.com/weather/research/2009-10-13-wind-farms-weather-radar_N.htm (reporting that "[w]ind farms in upstate New York are interfering with National Weather Service Doppler radars, making it more difficult to detect and assess approaching lake-effect snowstorms").

[24] *See* D.B. Barrie & D.B. Kirk-Davidoff, *Weather Response to a Large Wind Turbine Array*, 10 ATMOS. CHEM. PHYS. 769, 774 (2010) (testing the effects of an extremely large wind farm and observing: "Atmospheric anomalies initially develop at the wind farm site due to a slowing of the obstructed wind. The anamolies propagate downstream… quickly… [suggesting] that predictable influences on weather may be possible.").

[25] *See* Center for Biological Diversity, Inc. v. FPL Group, Inc., 83 Cal.Rptr.3d 588 (1st Dist.—2008). The court ruled that wildlife and birds are protected by public trust principles, explaining, "whatever its historical derivation, it is clear that the public trust doctrine encompasses the protection of undomesticated birds and wildlife." *Id.* at 599. The court declined to apply those principles to the conflict at hand because the plaintiffs had not followed proper protocol in getting the case to court. *Id.* at 591 & 607.

[26] American Wind Energy Association, *supra* note 16.

[27] Anya Kamenetz, *Why the Microgrid Could Be the Answer to Our Energy Crisis*, FAST COMPANY, July 1, 2009, *available at*

Despite the many troubling effects of large, out-of-the-way developments, significant government support continues to be directed to projects with many hundreds or thousands of end users. The U.S. Department of Energy has set as a goal that the United States obtain more than twenty percent of its electricity from alternative energy sources such as solar or wind power,[28] much of it to be produced in large-scale facilities. As government pushes for greater use of alternative energy, demand by large-scale alternative energy producers for land is also growing. As one measure, the Bureau of Land Management has received four hundred applications for large solar and wind plants covering over two million rural acres.[29] The question now is not whether energy sprawl will occur, but to what extent it may be contained.

B. The Debate

Reaction to the Nature Conservancy's report has been mixed. Some have questioned the methods of the report. Others have attempted to use the report's findings for political gain. Still others have simply ignored it.

Perhaps the most vehement criticism of the methodology of the report so far has come from Matthew Wasson, an ecologist and the director of programs for an environmental nonprofit called Appalachian Voices. He criticized the report's reliance on "reports, fact sheets, and brochures" to estimate the number of acres per unit of energy for each method of production.[30] Wasson also argued that focusing on acreage unacceptably minimized the environmental impact of coal mining, in particular.[31] Coal mining often involves shearing off mountain tops, disrupting ecosystems, and polluting waterways, among other negative impacts not included in a direct land disturbance (acreage) measure. Finally, in Wasson's mind, the term "energy sprawl" armed those who oppose alternative energy with a readily available catchphrase to frame

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http://www.fastcompany.com/magazine/137/beyond-the-grid.html?page=0%2C0#self.

[28] THE SMART GRID, *supra* note 4, at 21.

[29] Kamenetz, *supra* note *27*.

[30] Matt Wasson, App Voices' Matt Wasson Finds Major Flaws in the Nature Conservancy's "Energy Sprawl" Report, Oct. 9, 2009, *at* http://www.appvoices.org/index.php?/frontporch/blogposts/app_voicess_dr_matt_wasson_finds_major_flaws_in_the_nature_conservancys_ene/. *But see* MCDONALD ET AL, *supra* note 11, at 7 (identifying the source of most data as the Energy Information Administration's National Energy Modeling System, "a comprehensive econometric model of U.S. energy production, imports, and consumption").

[31] Wasson, supra note 30.

their opposition. He suggested that environmentalists "strike that buzzword from their lexicons and literature entirely."[32]

Unfortunately for Wasson, at least one politician has already taken up the energy sprawl mantle to make a political point. A month after the Nature Conservancy report was released, U.S. Senator Lamar Alexander wrote an opinion piece for the *Wall Street Journal*.[33] Drawing from the report's statistics regarding the land-intensivity of wind power generation, Senator Alexander criticized plans of the Obama administration to generate twenty percent of the nation's electricity from wind, stating that doing so would require setting aside a land area the size of West Virginia and constructing nineteen thousand miles of high-voltage transmission lines.[34] In the piece, he also argued that the country should look more seriously at nuclear energy, the kind of energy the report identified as being among the least land-intensive.[35]

Similarly, advocates of nuclear energy in Iowa believe that the report supported their push for a second nuclear reactor in the state.[36] Other residents of Iowa, the state with the second highest level of wind energy production,[37] reportedly ignored or rejected the Nature Conservancy's assessment.[38] The Cedar Rapids-based *Gazette* interviewed the executive director of the Iowa Renewable Fuels Association, a group that supports biofuels. He claimed that the report failed to take into account the fact that grains for biofuels were being grown as efficiently as ever, because of better seed genetics and agricultural practices.[39] In other words, the report's focus on land utilized by energy production is deceptive, in that while the full environmental impact of activities like coal mining is not taken into account, the full impact of biofuel production, which can easily measured by the number of farms growing crops, is taken into account.

In light of these and other criticisms, the lead author of the report, Robert McDonald, has subsequently explained that the

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[32] *Id*.
[33] Lamar Alexander, *Energy "Sprawl" and the Green Economy*, WALL ST. J., Sept. 17, 2009.
[34] *Id*.
[35] *Id.* (urging readers: "Before we find ourselves engulfed in energy sprawl, it's imperative we take a closer look at nuclear power.").
[36] *See* David DeWitte, *Iowans Not Buying Into "Energy Sprawl" Argument*, GAZETTE ONLINE, Jan. 19, 2010, *at* http://gazetteonline.com/local-news/2010/01/19/iowans-not-buying-into-'energy-sprawl'-argument (interviewing a nuclear energy advocate).
[37] *See* AMERICAN WIND ENERGY ASSOC., ANNUAL WIND INDUSTRY REPORT 8 (2009), *available at* http://www.awea.org/publications/reports/AWEA-Annual-Wind-Report-2009.pdf (identifying Iowa as having 1,560 megawatts of wind power capacity, behind Texas with 2,671 megawatts of capacity).
[38] *See* DeWitte, *supra* note 36.
[39] *See id*.

scope of his report was limited. He, on behalf of the Nature Conservancy, intended simply to ensure that land use issues were being considered—along with other measures such as energy security, cost effectiveness, job creation, energy independence, and economic issues—as legislation relating to alternative energy is drafted and implemented.[40] He neither intended to provide an endorsement of nuclear energy nor a critique of renewable energy.[41] Rather, he intended to promote "energy by design": avoiding development when possible, minimizing impacts if development is necessary, and compensating for unavoidable negative impacts.[42] Unlike Senator Alexander, McDonald praised the Obama administration's efforts to permit certain renewable energy projects after thorough environmental reviews, stating that such a process exemplified the kind of proper management the report hoped to support.

From my perspective, the importance of the Nature Conservancy report did not lie in its specific findings relative to each method of production, but rather in its identification of an intriguing measure of the impact of methods of energy production. Intuitively, the findings make sense: Producing energy impacts land. The lesson is not that alternative energy should be avoided, but that careful attention must be paid to its scale and siting.

II. Microgrids

Some people believe that we must choose between large facilities that generate alternative energy but destroy the environment, or the status quo.[43] If that were the case, the problem of energy sprawl would seem insurmountable. A third option, however, exists: the alternative energy microgrid, which deploys distributed generation technologies on a small scale. Although the concept of the microgrid has been used in engineering circles for a decade, it is relatively new in legal academia, so it warrants further

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[40] *See* Rob McDonald, The Lessons I've Learned from "Energy Sprawl," Sept. 17, 2009, *at* http://blog.nature.org/2009/09/energy-sprawl-rob-mcdonald-nature-conservancy/ (hereinafter "Lessons I've Learned"); Rob McDonald, Energy Sprawl and the Importance of Fact, Aug. 26, 2009, *at* http://blog.nature.org/2009/08/energy-sprawl-ethanol-rob-mcdonald/.
[41] Lessons I've Learned, *supra* note 40. Nuclear energy requires large capital outlays and raises safety concerns, among other problems not captured by the concept of energy sprawl.
[42] *Id*.
[43] *See*, *e.g.*, Dinnell & Russ, *supra* note 22, at 538 (presenting these two options in the wind farm context as a "Hobson's choice," though the options really presented a false dilemma, since there are more than two options).

explanation.[44] After clarifying the concept, this Part explains why the microgrid—and alternative energy microgrids, in particular—can help reduce the spread of energy sprawl.

A. The Definition

To understand the microgrid, one must first understand the concept of distributed generation. Distributed generation, also known as on-site generation or distributed energy, refers to the production of electricity by a small-scale source located at or very near the end users it serves.[45] Energy production thus occurs in distributed, or decentralized locations, rather than at one central point. A distributed generation system often contains the generating equipment, controls for fluctuations in loads, storage devices, and monitoring equipment.[46] Distributed generation may either co-exist with and link to the central grid (that is, the traditional, centralized network, often serving tens of millions of customers on a regional basis), or exist off the grid.

Microgrids organize distributed generation technology into a closed, low-voltage system that may address the needs of multiple users using multiple kinds of technologies.[47] A microgrid might, for example, utilize two kinds of distributed generation—a fuel cell, stored underground, and a photovoltaic solar array, located on multiple existing roofs—and storage equipment to serve an entire block of homeowners.[48] During the day, when the sun shines, the neighbors might use the energy produced by the photovoltaic array, storing the energy being produced by the fuel cell until nighttime. Meanwhile, excess heat from the fuel cell might be channeled into a heat recovery system that heats water and/or spaces within the homes.

Microgrids also present the opportunity for real-time management of aggregate production and loads. A Dutch company has developed various technologies that allow end users

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[44] The term "microgrid" or "micro-grid" appeared in just twelve articles in the Journal and Law Review database of Westlaw, searched by the author on Feb. 12, 2010. However, this Article is not the first to advocate for the use of microgrids. *See*, *e.g.*, Robert DeLay, *Solar Power & NYC Schools: Good Government and Electric Sparkplug*, 19 FORDHAM ENVTL. L. REV. 161 (2009) (citing the suggestion from the Center for Sustainable Energy at Bronx Community College to make microgrids legal in New York state).

[45] *See supra* note 5.

[46] THE CERTS MICROGRID CONCEPT, *supra* note 6, at 1.

[47] *See supra* note 6.

[48] Experts agree that while no technology is perfect (microturbines and fuel cells, for example, run natural gas), such technologies are far cleaner than conventional combustion engines. *See*, *e.g.*, THE CERTS MICROGRID CONCEPT, *supra* note 6, at 1 (representing the premiere nationwide research group investigating alternative energy microgrids).

to manage microgrids through an accessible central control system.[49] These products, which include an energy modem, software, and user interface, help end users (and managers) manage local energy networks.[50] Homes could be connected to this monitoring system through individual meters, and neighbors could work out a tariff that reflects the cost of installing and maintaining the infrastructure.

Like individual distributed generation facilities, microgrids could either tie to the grid or exist apart from it. If integrated into the grid, microgrids could connect as a single, self-controlled entity, like any other end user.[51] As day-to-day needs fluctuate, grid-connected microgrids could either draw power from the central grid or sell excess power to the local utility under applicable state net metering rules. In systemic emergencies, the microgrid could be shut off from the central grid altogether, both protecting energy needs of the users of the microgrid and protecting the central grid from unexpected surges.

Potential users of microgrids must review many variables to determine the best design of the microgrid from the outset.[52] Flexibility to respond over time to changes in demand and other circumstances, however, is also important. Ideally, a microgrid would function as a peer-to-peer system, that is, a system without a critical master controller essential to operation. It would also be a plug-and-play system—a system in which a new technology might be placed at any point without undue disruption, like home appliances are placed within a home.[53] With these two characteristics, microgrids can respond quickly and efficiently to user needs.

Researchers across the country have ensured that the system described above, and variations thereof, are feasible from a technical standpoint.[54] For at least a decade, the Consortium for

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[49] Qurrent: The Local Energy Company, Products, *available at* http://www.qurrent.com/eng/products.html (last visited Feb. 12, 2010).
[50] *Id*.
[51] *See* THE CERTS MICROGRID CONCEPT, *supra* note 6, at 1 & 9-10 (describing the concept of the CERTS MicroGrid, which has such a feature and is now the standard model for microgrid connectivity).
[52] *See*, *e.g.*, Hoff, *supra* note 6, at 2 (identifying six variables for determining microgrid characteristics: customer type, number of customer, types of distributed generation technologies, generation unit size, number of generation units, and level of system reliability).
[53] *See* Robert H. Lasseter, Microgrids and Distributed Generation, Sept. 2007, at 4, *available at* http://www.pserc.wisc.edu/ecow/get/publicatio/2007public/lasseter_asceg2-colum_2007.pdf.
[54] *See* Consortium for Electric Reliability Technology Solutions, Publications, *at* http://certs.lbl.gov/certs-pubs.html (last visited Feb. 12, 2010) (listing eighteen technical publications on microgrids alone). *See*, *e.g.*, Hassan Nikkhajoei &

Electric Reliability Technology Solutions (CERTS) has taken the lead on research on the optimization of microgrid performance. CERTS includes four national research labs, nine universities, and eight industry groups[55] which aim to transform the electric grid into something more reliable, responsive, and transparent.[56] Research from CERTS participants and others has revealed that microgrids stand ready to be deployed.

B. Why Microgrids

With this understanding of microgrids, their prospective role in mitigating energy sprawl becomes clear. Microgrids can provide energy in real time to small groups of end users from a location in and around existing development. They are flexible and adaptable, and match the scale of demand, which for three-quarters of the users in this country is exceptionally small.[57]

Microgrids present a compelling alternative to the current mode of generating power in the United States, which primarily occurs through a network of large-scale centralized facilities. Microgrids reduce energy sprawl because they increase capacity without relying on massive, land-intensive transmission lines that large-scale facilities need to transport power to customers.[58] Nor do they usually require new parallel infrastructure for other utilities—such as water for solar panels, or natural gas for fuel cells and microturbines—because they are typically located in

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Robert H. Lasseter, *Distributed Generation Interface to the CERTS Microgrid*, 24 I.E.E.E. TRANSACTIONS ON POWER DELIVERY 1598 (2009) (articulating a framework by which the resources of a distributed generation system can be channeled into special kind of microgrid, the CERTS MicroGrid, which can be separated and reconnected from the central grid seamlessly).

[55] Consortium for Electric Reliability Technology Solutions, Research Performers, *at* http://certs.lbl.gov/certs-org-rp.html (last visited Feb. 12, 2010) (listing Berkeley, Oak Ridge, Pacific Northwest, and Sandia among the national labs, as well as listing the universities and industry groups involved).

[56] *See* Consortium for Electric Reliability Technology Solutions, Vision, *at* http://certs.lbl.gov/certs-vision.html (last visited Feb. 12, 2010) (expressing a fourfold vision, including the transformation of the electric grid into an intelligent network, the enhancement of reliability management through market mechanisms; the empowerment of customers to manage their energy use; and the seamless integration of distributed technologies).

[57] *See* AMORY LOVINS, SMALL IS PROFITABLE: THE HIDDEN ECONOMIC BENEFITS OF MAKING ELETRICAL RESOURCES THE RIGHT SIZE 2 (2009) (noting that "[t]hree-fourths of U.S. residential and commercial customers use electricity at an average rate that does not exceed 1.5 and 12 kilowatts respectively, whereas a single conventional power plant produces about a million kilowatts").

[58] *See* CA. ENERGY COMM'N PUB. INTEREST ENERGY RESEARCH, *supra* note 5, at 6 (indicating the "value of reducing 'foot-print' or space needed by generation, transmission and distribution system capacity" as a benefit of distributed generation).

areas already served by such utilities. If effectively deployed across the country, microgrids could reduce demand on the grid itself, which would reduce the need for additional transmission and distribution capacity, and thereby reduce the amount of land and habitat occupied or affected by energy infrastructure.

Significant up-front outlays of capital for physical infrastructure are not the only expense of a large facility. Currently, approximately one-third to one-half of consumers' electric bills go toward the maintenance of existing large-scale infrastructure.[59] In addition, sunk costs cannot be recovered if populations shift; our existing energy infrastructure is extremely difficult to move or modify. Microgrids that incorporate plug-and-play technology provide great flexibility for users, who can move equipment and modify systems as circumstances require.[60] As Amory Lovins of the Rocky Mountain Institute has argued, while utilities have focused "on a few genuine economies of scale (the bigger, the less investment per kW)[, they have] overlooked larger *dis*economies of scale in the power stations, the grid, the way both are run, and the architecture of the entire system."[61]

Microgrids present an opportunity to re-configure these diseconomies of scale and make the overall energy infrastructure in this country more reliable and more efficient. Currently, electric power interruptions—including noise, distortions, high voltage spikes, and instable frequencies—cost industrial, commercial, and residential consumers eight billion dollars annually.[62] Disruptions to the grid can have a domino effect, with the U.S. Department of

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[59] THE SMART GRID, *supra* note 4, at 18.
[60] *See* text accompanying note 53.
[61] *See* LOVINS, *supra* note 57, at 2 (emphasis in original) (noting that "[t]hree-fourths of U.S. residential and commercial customers use electricity at an average rate that does not exceed 1.5 and 12 kilowatts respectively, whereas a single conventional power plant produces about a million kilowatts"). The book documented two hundred benefits of distributed generation.
[62] KRISTINA HAMACHI LACOMMARE & JOSEPH H. ETO, ERNEST ORLANDO LAWRENCE BERKELEY NATIONAL LABORATORY, UNDERSTANDING THE COST OF POWER INTERRUPTIONS TO U.S. ELECTRICITY CONSUMERS xi (2004), *available at* http://certs.lbl.gov/pdf/55718.pdf. *See also* THE SMART GRID, *supra* note 4, at 8 (noting that the Northeast blackout of 2003 resulted in a six billion dollar economic loss, while a one-hour outage at the Chicago Board of Trade in 2002 resulted in twenty trillion dollars in delayed trades); R. BRENT ALDERFER ET AL, U.S. DEP'T OF ENERGY DISTRIBUTED POWER PROGRAM, NAT'L RENEWABLE ENERGY LABORATORY, MAKING CONNECTIONS: CASE STUDIES OF INTERCONNECTION BARRIERS AND THEIR IMPACT ON DISTRIBUTED POWER PROJECTS 1 (2000), *available at* http://www.nrel.gov/docs/fy00osti/28053.pdf (arguing that distributed generation could improve reliability and save consumers billions of dollars annually); ROBERT GALVIN ET AL, PERFECT POWER: HOW THE MICROGRID REVOLUTION WILL UNLEASH CLEANER, GREENER, AND MORE ABUNDANT ENERGY 15-18 (2009) (describing the inefficiencies of the numerous regional power failures in 2006-2008).

Energy warning of "a cascading series of failures that could bring our nation's banking, communications, traffic, and security systems among others to a complete standstill."[63] Decentralization of power sources provides greater reliability, because if one power source goes down, other power sources can remain fully functional.[64] For these reasons, decentralization via the microgrid could help address concerns of terrorist attacks on American energy infrastructure. Decentralized microgrids can serve very remote sites, where development is necessary (not sprawl).

Microgrids' operation also provides a more efficient alternative to individual distributed generation. With individual distributed generation, a single user must rely on a single technology to meet all energy needs. With microgrids, a variety of configurations and sources enables different energy needs to be met at different times by different equipment.[65] Wind or solar power, which can be used when the weather conditions allow, could be combined with steady-stream energy generators such as geothermal wells to meet varying demands.[66] In microgrids that serve multiple users, users' different needs at different times of the day help to smooth out demand. In other words, there are fewer spikes and troughs in use than in a system with one user; with fewer fluctuations in demand, the microgrid's power can be more steadily utilized.

Moreover, microgrids can use waste heat more efficiently than individual distributed generation systems can, because one technology that produces waste heat can be combined with another technology that utilizes it.[67] This phenomenon, called cogeneration or combined heat and power, improves dramatically on traditional, centralized systems, because the production of heat is closer to the point of use and because heat production can be better matched to heat demand.[68] In traditional, centralized systems, half to three-quarters of such heat dissipates without

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[63] THE SMART GRID, *supra* note 4, at 9.
[64] *See* Lasseter, *supra* note 53, at 1 & 3.
[65] *Id.* at 4 (observing that: "Indiscriminate application of individual distributed generators can cause as many problems as it may solve. A better way to realize the emerging potential of distributed generation is to take a system approach which views generation and associated loads as a subsystem or a 'microgrid.'").
[66] Note that it may be especially important to ensure that fuel cells are paired with a technology that can help smooth demand. Because fuel cells produce a steady stream of energy, they must be built to the peak capacity. If connected to a grid, fuel cells feed electricity into the grid in off-peak hours and pull from the grid during peak hours. Managing fuel cell input and output is an important consideration in microgrid situations.
[67] *See* King Thesis, *supra* note 6, at 3 (stating that "the development and adoption of micro-grids with combined heat-and-power applications" are the only way for microgrids to reach their full potential).
[68] *See* THE CERTS MICROGRID CONCEPT, *supra* note 6, at 5.

being used, because energy production usually occurs very far away from end users.[69] Using heat at the site of its creation can more than double the overall efficiencies of the microgrid.[70] Such increases in efficiency add yet another benefit of microgrids over our current method of siting and utilizing energy infrastructure.

Lower infrastructure costs, flexible configurations, and the ability to use waste heat result in big savings to microgrid users. Studies have shown that microgrids have the potential to save users twenty to twenty-five percent in energy costs over the cost of individual distributed generation.[71]

It may be important to conclude this section with some thoughts about the feasibility of small-scale energy sharing among neighbors. Some may doubt the ability of neighbors to cooperate enough to conceive, execute, and maintain something as complicated as a microgrid. Reviewing the American experience with district energy systems may help to assuage these doubts. District energy systems are small-scale systems that offer institutions or groups of individuals certain economies of scale of scale to heat and/or cool several buildings at once through a small- or mid-sized facility.[72] (Heating and cooling are not as regulated as electricity and other energy production.[73]) As one example of a successful district energy system, a condominium community in New Hampshire uses a central pellet boiler plant which uses locally produced biomass fuel for heat and hot water.[74] The twenty-nine units range in size, and some are freestanding

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[69] *See id.* at 4.

[70] *See* Robert H. Lasseter & Paolo Piagi, Microgrid: A Conceptual Solution, June 2004, at 1-2, *available at* http://certs.lbl.gov/pdf/mg-pesc04.pdf (stating that "[t]he size of emerging generation technologies permits generators to be placed optimally in relation to heat loads" and that the small scale of heat production "offers greater flexibility in matching to heat requirements").

[71] King Thesis, *supra* note 6, at 49 (analyzing system net present value savings from distributed generation and microgrids for hospital, office, mall, "urban mix" and other users).

[72] Ideally, the users of district energy, like the users of future microgrids, have different energy needs that vary throughout the day, a circumstance that flattens demand. An institution like a university, with different use profiles for different spaces (such as dormitories, laboratories, classrooms, auditoriums, and gyms), can take full advantage of a district energy system.

[73] *See*, *e.g.*, OR. REV. STAT. ANN. § 757.005(1)(a)(F) & (G) (West 2003) (exempting from public utility regulation "[a]ny person furnishing heat, but not delivering electricity or natural gas to its customers" and entities "furnishing heat to a single thermal end user from an electric generating facility, plant or equipment that is physically interconnected with the single thermal end user").

[74] Nubanusit Neighborhood & Farm, Green Features, *available at* http://www.peterboroughcohousing.org/green_features.htm (last visited Feb. 12, 2010).

buildings.[75] The central plant has helped the community to obtain the highest rank in the widely-recognized certification system administered by the U.S. Green Building Council.[76] Concerns about the safety, utility, or effectiveness of district energy systems, which like microgrids serve multiple distinct physical spaces, have been greatly reduced as such systems have become more common.

Moreover, various groups around the country are building networks that rely on the mutual support of neighbors to achieve alternative energy goals. In the nation's capitol, for example, several solar cooperatives have been established to share information, ideas, and labor.[77] In Maryland, a chamber of commerce has worked with a local clean energy broker to negotiate bulk rates for the purchase of wind power.[78] In New Hampshire, neighbors install alternative energy equipment for neighbors, in "energy raising" events not unlike the barn raising events of yesteryear.[79] These efforts reveal a growing grassroots initiative among neighbors to mobilize for alternative energy. The time to capitalize on this movement by facilitating the proliferation of microgrids is now.

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[75] Nubanusit Neighborhood & Farm, Our Homes, *available at* http://www.peterboroughcohousing.org/the_homes.htm (describing the homes as having an energy efficient design) (last visited Feb. 12, 2010).

[76] Nubanusit Green Features, *supra* note 74 (describing the Platinum certification obtained through the LEED program).

[77] *See*, *e.g.*, Capitol Hill Energy Cooperative, Solar Panel Project, *available at* http://capitolhillenergycoop.googlepages.com/solarroofproject (describing the process by which D.C. property owners can install solar panels on their homes and indicating that over one hundred individuals were participating in the information exchange); Common Cents Solar Cooperative, About, *available at* http://www.commoncentssolar.org/about.html (citing its mission not only to educate potential solar users but also to make the cost of solar cheaper through collective bargaining); Mount Pleasant Solar Cooperative, About Us, *available at* http://www.mtpleasantsolarcoop.org (describing the network of seventy-plus households that negotiate bulk purchase discounts and exchange information).

[78] Clean Currents, Rockville Chamber of Commerce Teams up with Clean Currents for First Ever Green Energy Buying Group, *available at* http://www.cleancurrents.com/index.php/Rockville-Chamber-of-Commerce-Teams-up-with-Clean-Currents-for-First-Ever-Green-Energy-Buying-Group (announcing the partnership which creates a green power buying group).

[79] The Plymouth Area Renewable Energy Initiative (PAREI), for example, has convened at least one hundred and twenty "energy raising" events to help individuals reduce the cost of solar installation. *See* Plymouth Area Renewable Energy Initiative, Home Page, *available at* http://www.plymouthenergy.org; Sarah Schweitzer, *Many Hands Make Light Work of Saving Energy; Neighbors Gather to Install Solar Power*, BOSTON GLOBE, May 8, 2008 (describing PAREI's efforts on a house in Sandwich, New Hampshire).

III. Thwarting Microgrids, Facilitating Sprawl

Despite their possible benefits, only a few microgrid projects have been attempted in this country, mostly in prototype or demonstration form.[80] Many regulatory, political, and economic barriers hinder the creation of microgrids and thus facilitate energy sprawl. Although an exhaustive treatment of these barriers goes beyond the scope of this Article, a brief survey reveals why the reforms described in Part IV are so necessary.

A. Regulatory Barriers

By far the biggest barrier to the creation of microgrids is contradictory, unclear, or hostile law. State legislatures and state public utility commissions have made it difficult to determine whether a microgrid project can be commenced. One critical question is whether a microgrid should be considered a public utility. State laws often define "public utility" to include any person or entity furnishing power to another, without regard to the number of recipients of such power and without exceptions for alternative energy or microgrids.[81] Such broad definitions would subject even a microgrid with two users to burdensome regulation, because public utilities must abide by very strict rules that determine allowable technologies, tariffs, technical requirements, and other parameters.

No state laws squarely address microgrids, and no comprehensive, publicly-available analysis of possible means to allow microgrids within current state law appears to exist. However, two studies have shed some light on current law and regulators' perceptions. In 2002, researchers at Carnegie Mellon University interviewed utility regulators in eight states to determine how their states treated microgrids.[82] They presented

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[80] *See supra* note 7.

[81] *See*, *e.g.*, IDAHO CODE ANN. § 61-129 (2007) (defining "public utility" to mean "every common carrier, pipe line corporation, gas corporation, electrical corporation, telephone corporation, water corporation, and wharfinger"); KAN. STAT. ANN. § 66-104(a) (2005) (defining "public utility" to mean "every corporation, company, individual, association of persons, their trustees, lessees or receivers, that now or hereafter may own, control, operate or manage, except for private use, any equipment, plant or generating machinery, or any part thereof"); NEV. REV. STAT. §§ 704.020(2)(a) (2007) (defining "public utility" to include "[a]ny plant or equipment, or any part of a plant or equipment, within this State for the production, delivery or furnishing for or to other persons, including private or municipal corporations, heat, gas, coal slurry, light, power in any form").

[82] M. Granger Morgan & Hisham Zerriffi, *The Regulatory Environment for Small Independent Micro-Grid Companies*, ELECTRICITY J. (2002), at 1, *available at* https://wpweb2.tepper.cmu.edu/ceic/pdfs/CEIC_02_07.pdf (noting

the regulators with several scenarios, including a scenario in which a for-profit commercial firm served twenty customers in an industrial park, as well as a cooperative operated by its customers.[83] Of the eight regulators, three indicated that microgrids in at least one presented scenario could be built, but only one of the three (the representative from Minnesota) indicated that small microgrids might be exempt from public utility classification and regulation.[84] None of the other states had an exemption for small numbers of customers.[85] Similar findings were obtained by a Carnegie Mellon Ph.D candidate in 2006. He surveyed twenty-seven state public utility commissions, asking then whether a microgrid is legal. Of those, seventeen said that the microgrid was "probably" or "definitely" legal, but only under very specific circumstances.[86]

In addition to muddling the creation of microgrids, state laws also fail to specify how microgrids might be regulated.[87] The 2002 survey mentioned above, for example, included questions related to interconnection with the central grids. The answers reflected at best, confusion, and at worst, obstruction by utilities, public utility commissions, and state legislatures.[88] The 2006 study showed that only four states of the twenty-seven surveyed had laws for individual distributed generation, tariffs, and interconnection procedures which could apply to micro-grids.[89] While both studies are several years old and the sample sizes are not large, the findings reflect current concerns across jurisdictions. More broadly, ambiguities in the law create fundamental uncertainties about the legality and treatment of microgrids, dampening investment even where microgrids might (with creative lawyering) be possible.[90]

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that some of the eight were current regulators, and some were former regulators).
[83] *Id.* at 2-3.
[84] *Id.* at 2.
[85] *Id*.
[86] *See* Douglas E. King, The Regulatory Environment for Interconnected Electric Power Micro-Grids: Insights from State Regulatory Officials, Working Paper, May 2008, at 1, *available at* https://wpweb2.tepper.cmu.edu/ceic/pdfs/CEIC_05_08.pdf (hereinafter "King Regulatory Environment").
[87] *See id.* at 1 ("No states have clear guidance for the regulatory oversight of micro-grid systems once they are installed, and most respondents indicated that such oversight would be conducted on a case-by-case basis.").
[88] Morgan & Zerriffi, *supra* note 82, at 3 (stating that "[n]one of the eight respondents gave a simple yes" as to whether terms and conditions would be "clear and predictable").
[89] *See* King Regulatory Environment, *supra* note 86, at 1.
[90] *Id.* at 6.

A few states have passed laws that could open the door for microgrids to be created and operated. Oregon, for example, defines "public utility" as an entity that "operates, manages or controls all or a part of any plant or equipment in this state for the production, transmission, delivery or furnishing of heat, light, water or power, directly or indirectly to or for the public."[91] It excludes from public utility regulation any entity or person that provides heat, light, or power from: any energy resource to fewer than twenty residential customers; solar or wind resources to any number of customers; or biogas, waste heat or geothermal resources for nonelectric generation purposes to any number of customers.[92] This definition implies that microgrids with fewer than twenty customers may be legal, although no legislation specifically provides for their implementation. Across the country, meanwhile, Connecticut has authorized municipalities to create energy improvement districts that can own and operate distributed generation technologies and combined heat and power, have multiple customers, and charge customers fees for their energy use.[93] The statute provides that such districts are neither electric distribution companies (a kind of public utility in the state) nor municipal electric utilities.[94] While the law on municipality-controlled energy improvement boards does not provide a similar capacity for private firms, it still represents a move in the right direction. That said, without comprehensive statutes that fully describe the treatment of microgrids, it is very unlikely that the barriers created by legal uncertainties can be removed.

B. Political Barriers

Any attempts to reform the law to facilitate microgrids will have to overcome objections from two politically active groups: utility companies and neighbors. This Subpart outlines the impact of these groups on current laws and policies.

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[91] OR. REV. STAT. ANN. § 757.005(1)(a)(A) (West 2003).
[92] OR. REV. STAT. ANN. § 757.005(1)(a)(C) (West 2003).
[93] *See* CONN. GEN. STAT. ANN. § 32-80a(a)(1) (West 2001 & Supp. 2009) (defining "energy improvement district resources") and § 32-80a(c) (allowing an energy improvement district to, among other things, "[f]ix [and collect] fees, rates, rentals or other charges for the purpose of all energy improvement district distributed resources owned by the energy improvement district board" and "operate and maintain all energy improvement district distributed resources owned or leased by the board ad use the revenues from such resources for the corporate purposes of the board").
[94] CONN. GEN. STAT. ANN. § 32-80a(d)(1)-(2) (West 2001 & Supp. 2009).

1. Utility Companies

Utility companies, which tend to object to distributed generation (and, by extension, microgrids), have a significant impact on state law and on the financial feasibility of distributed generation projects. They fight to protect their monopolies over service areas granted by the federal government and by state governments.[95] The Department of Energy described this protective impulse and identified utility companies as major impediments to regulatory reform for distributed generation.[96] Although utilities view any customer generation as potentially detrimental, their opposition to microgrids is far greater than their opposition to individual distributed generation, because the microgrid involves exchanges of power and payment between multiple users.[97] Such exchanges potentially infringe on the monopolies enjoyed by utility companies, and so are or would be vigorously opposed.[98] Microgrids may impose other costs on utilities, such as: an increase in the per-user share of capital costs for infrastructure maintenance; the need to provide standby power over normal capacity; system upgrades; the cost of safety and maintenance issues related to interconnection of the microgrids; and the cost of uncertainties in planning for infrastructure expansion or modification.[99]

One way utilities slow adoption of distributed generation laws is by raising false concerns about technical feasibility and safety. For example, they often claim that distributed generation will supply power to the utility-run central grid when the grid is down, endangering workers who believe they are fixing de-

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[95] Only in rare instances are service areas open to competition. *See* King Regulatory Environment, *supra* note 86, at 6.
[96] ALDERFER ET AL, *supra* note 62, at iv (observing that "regulatory incentives drive the distribution utility to defend the monopoly against market entry by distributed power technologies" and that barriers faced by distributed generation "grow out of long-standing regulatory policies and incentives designed to support monopoly supply and average system costs for all ratepayers").
[97] King Thesis, *supra* note 6, at 3 ("Unlike conventional DER applications, micro-grids pose a perceived market threat to regulated utilities because electric power is exchanged from one customer to another within the micro-grid—a service that is currently restricted only to regulated utilities."). *See also id.* at 83 ("Electric utilities have historically viewed customer-generators—those who have their own on-site generation—as financial, technical, and safety risks.").
[98] *See* M Morgan & Zerriffi, *supra* note 82, at 5 (interviewing eight state public utility commissioners, all of whom indicated that utilities would oppose microgrid legislation vigorously).
[99] Douglas King & M. Granger Morgan, Carnegie Mellon University, Guidance for Drafting State Legislation to Facilitate the Growth of Independent Electric Power Micro-Grids (2003), at 2 *available at* https://wpweb2.tepper.cmu.edu/ceic/pdfs/CEIC_03_17.pdf.

energized lines, or causing fires.[100] While these fears may have once been reasonable, technology to prevent this effect, known as "islanding," exists and has been used successfully for over two decades.[101] In addition, national safety standards, most prominently a standard issued by a well-respected international electrical engineering association, have been developed for the interconnection of distributed generation to the central grid.[102] The majority of the states have begun to adopt model safety standards,[103] although such adoption has not resulted in a clear legal framework for microgrids. Utility companies have also argued that distributed generation equipment threatens power quality.[104] Here, too, new technologies have emerged that protect against negative effects on power quality.[105] Other issues have been carefully analyzed and resolved by CERTS and other research and industry groups.

By raising false concerns through public hearings, lobbying, and other activities, utility companies worry lawmakers already confused about the technical aspects of distributed generation. This impact is particularly significant because utilities are often the most prominent group involved in drafting energy rules at the state level. Nonprofits, individually affected parties, and manufacturers of distributed generation and microgrid equipment have been active, but as the previous Subpart reveals, they have not proven to be as well-organized, or as effective, in getting their initiatives passed into law.

Beyond lawmaking, utilities have a profound impact on the financial feasibility of distributed generation. This impact arises from utilities' ability to set tariffs and policies on end users within their jurisdiction. The U.S. Department of Energy has documented numerous examples of utilities charging unfair and outsized backup tariffs—supplemental, backup, and standby tariffs that distributed generators are required to pay to ensure access to the

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[100] *See* R. ALDERFER ET AL, *supra* note 62, at 9; VARNADO & SHEEHAN, supra note 8, at 29-30.
[101] ALDERFER ET AL, *supra* note 62, at 9; VARNADO & SHEEHAN, supra note 8, at 30-32.
[102] *See*, *e.g.*, Institute of Electrical and Electronics Engineers Standard 1547, Standard for Interconnecting Distributed Resources with Electric Power Systems (2009).
[103] *See* VARNADO & SHEEHAN, supra note 8, at 19 (indicating that thirty-one states had to date considered or adopted new interconnectivity safety standards).
[104] ALDERFER ET AL, *supra* note 62, at 10; VARNADO & SHEEHAN, supra note 8, at 32-34 (explaining that "[p]ower quality is important because electronic devices and appliances are designed to receive power within a designated range of voltage and frequency parameters, and deviations outside those ranges can cause appliance malfunction or damage").
[105] ALDERFER ET AL, *supra* note 62, at 10.

grid.[106] Sometimes, the proposed tariffs have even exceeded the equivalent cost of the energy produced by the distributed generator.[107] In addition, utilities, which enjoy monopolies over buying back excess energy, have tended to offer very low buyback rates.[108] Low buyback rates mean that power produced during off-peak periods which is not used by the microgrid cannot necessarily be fed back into the central grid, and sold back to the utility, at rates that would help offset the costs of investing in distributed generation. Finally, utilities sometimes refuse to serve users of distributed generation, that is, they refuse to connect them to the grid. Backup generators that would alleviate worries of being without power—that is, protect microgrid users in a worst-case scenario—add so many costs that entire projects are abandoned. The implication of these practices on the financial feasibility of distributed generation, and by extension microgrids, is clear. If past behavior is any indication, utility companies will continue to obstruct any reform that would facilitate microgrids.

2. Neighbors

Neighbors, like utility companies, also have significant influence on the future of microgrids, although neighbors influence local law and local policies more than state law and statewide policies. More specifically, neighbors have played and will play a big part in land use issues, which are traditionally local in nature.

I have written elsewhere about localities' role in siting alternative energy technology and will summarize my findings here.[109] Of nearly forty thousand local governments nationwide, less than a hundred have squarely addressed technologies like the ones that could be deployed in a microgrid.[110] Tens of thousands of localities have either barred or ignored such technologies, in the

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[106] ALDERFER ET AL, *supra* note 62, at 20.
[107] *Id.* at 22 (describing a utility's attempt to charge $144,000 annually for a backup tariff for a facility that would generate just $100,000 worth of electricity annually).
[108] *Id.* at 28 (stating that "most current siting processes were designed for large power plants, thus posing barriers to distributed power analogous to those more fully discussed in this report").
[109] *See* Sara C. Bronin, *The Quiet Revolution Revived: Sustainable Design, Land Use Regulation, and the States*, 93 MINN. L. REV. 231 (2008).
[110] U.S. CENSUS BUREAU, U.S. DEP'T OF COMMERCE, GOVERNMENT ORGANIZATION: 2002 CENSUS OF GOVERNMENTS 5 (2002), *available at* http:// www.census.gov/prod/2003pubs/gc021x1.pdf (indicating that 38,967 general-purpose governments exist nationwide); Bronin, *supra* note 109 (indicating that seventy-five of these governments have squarely addressed green building, but not providing a separate figure for localities that have addressed alternative energy).

laws either as written or as applied.[111] Local laws that thwart alternative energy projects include zoning ordinances, aesthetic controls, and historic preservation rules.

Examples of local groups using these laws to erect barriers to alternative energy equipment abound, particularly with respect to wind energy. An Oklahoma city changed its ordinances to prevent a wind farm from locating there.[112] A New York town enacted a moratorium on wind turbine towers; a prospective wind farm developer sued the town (but lost).[113] Even outside of formal legal actions, neighbors have managed to wrangle informal agreements and concessions from wind energy generators fearful of formal protests.[114]

Wind turbines may be taller and bulkier than some other alternative energy generating technologies, but each technology has physical features that may make their proximity undesirable to potential neighbors: Solar collectors can be unsightly; microturbines can create a disconcerting hum; fuel cells are essentially large, trailer-sized boxes that are hardly beautiful; geothermal wells must be drilled fifteen hundred feet underground with loud equipment. To be sure, technology is improving, and many old stereotypes no longer apply. But in too many communities, neighbor involvement in local decision-making processes can help to kill microgrid projects that the utilities, and unfavorable state laws, do not. The equipment that supports microgrids has to go somewhere. If too many neighbors object and the equipment cannot be located in previously developed locations, where the infrastructure to support it already exists, then energy sprawl will continue to spread.

As Parts I and II clarified, the need to facilitate alternative energy microgrids, and the distributed generation technologies that comprise them, is clear. In those communities that explicitly bar alternative energy technologies, concerted efforts must be made to

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[111] *See* Bronin, *supra* note 109, at 250-55.
[112] ALDERFER ET AL, *supra* note 62, at 20 (noting that the wind farm owner had been grandfathered in, so the farm could be sited in the town anyway).
[113] *See* Ecogen, LLC v. Town of Italy, 438 F.Supp.2d 149 (W.D.N.Y. 2006). The moratorium stated that "'the installation of wind turbine facilities in the Town of Italy may have an adverse affect [sic] upon the scenic and aesthetic attributes of the Town of Italy and a correspondingly detrimental influence upon residential and recreational uses as well as real estate values in the Town of Italy, unless properly controlled through zoning regulations.'" *Id.* at 153.
[114] *See*, *e.g.*, Jim Carlton, *Wind Turbines Leave Some in a Huff*, WALL ST. J., Jan. 14, 2010, *available at* http://online.wsj.com/article/SB10001424052748704586504574654591353003848.html (describing various tensions between property owners who install wind turbines and their neighbors, and informal arrangements such as a wind turbine owner's agreeing not to operate his turbine on weekends, when his neighbor gardens).

reverse course. In those communities that ignore alternative energy technologies, ambiguities must be resolved through careful redrafting. For a variety of reasons, however, localities are unlikely to move forward with major reforms.[115] In this limited respect, given the extra-local nature of energy sprawl, states may have a role in encouraging localities to facilitate microgrids—without ignoring neighbor objections—through carefully written state enabling statutes.[116]

C. Economic Barriers

Uncertainties about the price of regulatory conditions and unsubsidized, high costs per user deter investment in distributed generation and microgrid projects.[117] As noted above, utilities have the ability to arbitrarily set tariffs or engage in selective discount pricing.[118] Utilities' refusal to establish clear guidelines for microgrid users make basic budgeting, and predicting returns, extremely difficult. In addition, the relative cost per user of microgrids to other alternative energy infrastructure is very high. Microgrid physical infrastructure does not cost as much per unit of energy as large-scale, centralized facilities, because microgrids do not require extensive transmission and distribution systems.[119] However, the costs of microgrids must be borne by a smaller number of users than the costs of central grid infrastructure. This denominator problem comes into play when dealing with administrative costs such as costs related to environmental permitting and review, which may be the same for few-user projects as for many-user projects.[120] The per-user comparative

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[115] *See* Bronin, *supra* note 109, at 249-50, 255-60.
[116] *See id.* at 266-72 (describing how states can balance local autonomy and public policy goals of pursuing alternative energy).
[117] *See* THE CERTS MICROGRID CONCEPT, *supra* note 6, at 21(observing that rapidly changing commodity prices may deter investment in microgrids and stating that "it appears that emerging restructured electricity markets will deliver volatile commodity electricity prices and an erratic investment program that results in unpredictable electricity supply reliability").
[118] ALDERFER ET AL, *supra* note 62, at 18.
[119] Hoff, *supra* note 6, at 2.
[120] ALDERFER ET AL, *supra* note 62, at 18. Note that some states are already beginning to reduce administrative costs for small-scale projects. The New York Public Service Commission, for example, has decided that utility companies cannot require interconnection studies for facilities that produce fewer than ten kilowatts. *See* N.Y. Public Service Comm'n, Opinion No. 99-13, Case No. 94-E-0952, In the Matter of Competitive Opportunities Regarding Electric Service, Dec. 31, 1999. The Texas Public Utility Commission, meanwhile, allows utilities to require an interconnection study for distributed generation facilities, but the utility cannot charge the generator if it does not export power to the utility system or if it is smaller than certain set criteria. Tex.

costs looks even worse for microgrids in light of the lack of public subsidies for microgrids.[121]

Public subsidies for both individual distributed generation and large alternative energy facilities, on the other hand, run into the billions. Massive subsidies from all levels of government support individual distributed generation with one end user.[122] These subsidies—grants, tax credits, property tax exemptions, renewable energy credits, loan guarantees, and low-interest loans—help individuals offset the up-front and ongoing costs of installing and operating alternative energy technologies. These subsidies have worked well in encouraging many millions of individuals to embrace single-source distributed generation, although the ability of the vast majority of Americans to spend the money needed to match the government subsidies is admittedly limited. Moreover, the receipt of these subsidies is tied to the on-site consumption of all of the energy produced by the subsidized technology. So individuals who share energy, like microgrid operators, become ineligible for the incentive programs that make alternative energy financially feasible.[123] Across-the-board revisions to subsidy rules are certainly in order.

Government support has also been directed toward projects with many hundreds or thousands of end users, such as the wind turbine farms in West Texas or the solar installations in the New Mexico desert—projects that, while better than traditional forms of energy generation, nonetheless create undesirable energy sprawl. State and local governments justify efforts to attract such projects to their jurisdictions not only on environmental grounds, but also on economic development and job creation grounds. The public utility lobby has also helped increase financial support for large-scale projects that they control and operate.[124] As these projects

Public Utility Comm'n, § 25.211, Interconnection of Distributed Generation, Dec. 1, 1999.

[121] *But see* Press Release, *supra* note 7 (announcing $10 million in investing in three projects that appear to be microgrids).

[122] Numerous governments, and states in particular, provide a wide variety of subsidies. *See*, *e.g.*, TEX. TAX CODE § 11.27(a) (2010) (stating: "A person is entitled to an exemption from taxation of the amount of appraised value of his property that arises from the installation or construction of a solar or wind-powered energy device that is primarily for production and distribution of energy for *on-site use*.") (emphasis added).

[123] King Thesis, *supra* note 6, at 2-3 (noting that "[i]n order to be cost-effective, continuous-use applications require the DER customer to be interconnected with the utility grid so that the customer can sell excess power to the utility and purchase power from the utility during peak periods or on-site system failures").

[124] Kamenetz, *supra* note 27 ("Big utilities are pushing hard to do what they do best—getting the government to subsidize construction of multi-billion-dollar, far-flung, supersize solar and wind farms covering millions of acres, all connected via outside transmission lines.").

are being built, however, costs are being shifted to ratepayers and the general public. For one thing, large projects create energy sprawl, which itself imposes many hidden costs. For another, more strain is being placed on the existing grid. Experts suggest that modernizing the grid could cost up to one hundred billion dollars, a cost which will be borne by consumers—in other words, internalized by those given few options to opt out.[125] It would make a lot of sense for some of that investment to be dedicated toward the financial support of microgrids, which would result in reduced demand on the centralized grid and reduced transmission and distribution costs.

Except to the extent they influence, and are influenced by, the law, political and economic concerns are generally outside the scope of this Article. Yet articulating such concerns illuminates the many problems facing microgrids. Turning now to Part IV, we return to the law, and two ideas for resolving some of the regulatory barriers described in Part III.

IV. Thwarting Sprawl, Facilitating Microgrids

Slowing the spread of energy sprawl could be achieved in many ways.[126] The most effective option would be reducing consumption, which seems unlikely given Americans' unending appetite for energy. Other extremes—banning new transmission lines or refusing to subsidize any large-scale extra-urban energy projects—are equally infeasible. In this situation, modest reforms would work best. Accordingly, this Article suggests two modest, but potentially very effective, means of facilitating microgrids, which focus on the primary role the states play in energy regulation and land use. First, this Article recommends that the states be required to "consider" model standards for microgrid regulation. Second, it recommends that states provide guidance to local governments with respect to siting microgrid projects.

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[125] HAMACHI & ETO, *supra* note 62, at xi.

[126] The Nature Conservancy recommends four ways to reduce energy sprawl: first, reducing the area impacted by new energy development (a recommendation that seems circular); second, encouraging end-use generation; third, making any cap and trade bills flexible enough to include offsets from carbon capture and storage; and fourth, to engage in site selection and planning efforts to mitigate impact. *See* MCDONALD ET AL, *supra* note 11, at 6. The author of the report added in an interview that conservationists could advocate to maximize energy conservation and energy efficiency; build incentives for the use of abandoned or degraded land, rather than natural habitat; and site new energy projects away from sensitive species. Palmquist, *supra* note 3.

A. Regulatory Reform: "Considering" Model Standards

State legislatures and agencies must lead reforms for microgrid regulation. State public utility commissions regulate seventy-five percent of electricity in this country,[127] and they have more expertise with the creation and operation of distributed generation than other regulatory bodies, including the Federal Energy Regulatory Commission.[128] Although states' treatment of microgrids to date has been anything but impressive, there is some hope that they would comply with federal rules to consider model standards.

In fact, states recently complied with federal mandates to review two other aspects of distributed generation regulation: net metering and interconnection standards. The Federal Energy Policy Act of 2005 required state public utility commissions to consider a model interconnection standard, based on the Institute of Electrical and Electronics Engineers Standard 1547,[129] as well as to consider a model net-metering standard by 2008.[130]

This law was passed by Congress after it recognized the need for implementation of technical standards with at least some common elements across jurisdictions, to spur distributed generation. Ten years ago, the Department of Energy blamed lags in the development of distributed generation on the lack of "a national consensus on technical standards for connecting equipment, necessary insurance, reasonable charges for activities related to connection, or agreement on appropriate charges or payments for distributed generation."[131] The National Renewable Energy Lab, also in 2000, called "a patchwork of rules and regulations which defeat the economies of mass production that are natural to these small modular technologies" the biggest barrier to

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[127] JOSEPH H. ETO & KRISTINA HAMACHI LACOMMARE, ERNEST ORLANDO LAWRENCE BERKELEY NATIONAL LABORATORY, TRACKING THE RELIABILITY OF THE U.S. ELECTRIC POWER SYSTEM: AN ASSESSMENT OF PUBLICLY AVAILABLE INFORMATION REPORTED TO STATE PUBLIC UTILITY COMMISSIONS 3 (2008), *available at* http://certs.lbl.gov/pdf/lbnl1092e-puc-reliability-data.pdf.

[128] FERC does play a role in distributed generation projects. It controls all wholesale electricity transactions, including for distributed generation. And in 2005, FERC adopted interconnection standards for transmission-level (not distribution-level) interconnections with public utilities (defined under the federal statute) for projects smaller than 20 megawatts. Federal Energy Regulatory Comm'n, Order No. 2006 (Docket No. RM02-12-000), May 12, 2005.

[129] The full name of the standard is the Standard for Interconnecting Distributed Resources with Electric Power Systems.

[130] *See* 16 U.S.C. 2622(b)(3)(A)-(B).

[131] ALDERFER ET AL, *supra* note 62, at 34.

distributed generation.[132] Ideally, the Department of Energy and National Renewable Energy Lab recognized, manufacturers of distributed generation technology need some national standards, lest they have to manufacture fifty different technologies to accommodate state preferences.

The Federal Energy Policy Act requirements appears to have succeeded in abating these concerns and prompting states to review, modify, and standardize their policies on interconnectivity and net metering. During the period of review provided by Congress, thirty-one states adopted or amended their interconnection standards during the period where this was required.[133] Forty-two states have adopted net metering standards that allow distributed generators to sell excess energy back to the grid.[134]

These rules vary among states, based on the types of technologies, system size, system capacity, timing of payments, and the ownership of renewable energy credits.[135] But we are no doubt better off today than we would have been without the "consideration" requirement of the Federal Energy Policy Act. Moreover, the variety reflects our federalist structure, as states have been allowed to experiment with different reforms.[136] States can continue to experiment, without federal interference, provided that they have considered the larger context for their decisions.

Finally, states (and public utilities) may be eager to consider microgrids once they understand how microgrids can help

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[132] *Id.* at 21-23.

[133] VARNADO & SHEEHAN, supra note 8, at 19 (noting, however, that it is hard to say that these changes necessarily resulted from the Federal Energy Policy Act and that "[a] number of these states may have simply recognized the value of distributed generation and would have set about to reform state policies regardless of encouragement from" the Act).

[134] *Id.* at 11.

[135] *See* Interstate Renewable Energy Council, "Connecting to the Grid" Project State Interconnection Standards for Distributed Generation, Feb. 2010, *available at* http://irecusa.org/wp-content/uploads/2010/02/February_2010_IC_Table.doc (presenting a comparison of states' rules on interconnection, including limits on system capacity, insurance requirements, eligible renewable technologies, applicable sectors, and more); Interstate Renewable Energy Council, "Connecting to the Grid" Project
State and Utility Net Metering Rules for Distributed Generation, Feb. 2010, *available at* http://irecusa.org/wp-content/uploads/2010/02/February_2010_NM_Table.doc.

[136] Kate Galbraith, *California and Texas: Renewable Energy's Odd Couple*, N.Y. TIMES, Oct. 17, 2009, *available at* http://www.nytimes.com/2009/10/18/weekinreview/18galbraith.html?_r=1 (observing that states' experimentation can be helpful and stating, "[i]n the absence of sustained federal action to support clean energy and fight climate change, Texas and California are serving as important policy laboratories").

them meet their renewable portfolio standard goals.[137] Renewable portfolio standards, adopted by state legislatures, require public utilities to incorporate a certain percentage of alternative energy in their productive capacity, within a certain time period.[138] Not all states have adopted renewable portfolio standards, and those that do vary widely. Seventeen out of thirty states with renewable portfolio standards have targets of twenty percent or more, with Hawaii and Maine targeting forty percent of retail energy sales to come from renewables.[139] Sixteen states have provisions regarding solar or distributed generation in their renewable portfolio standard.[140] Such variation reflects the different factors—energy policy, economic development, the environment—that states must consider in enacting reforms.

This Article does not propose model rules that Congress should require the states to consider, because others, including CERTS researchers and the Carnegie Mellon researchers mentioned above, have already articulated potential model legal frameworks.[141] Without delving too far into the details, I believe a model standard should have several components: (1) an articulation of the state policy promoting alternative energy; (2) a definition of the term "microgrid" as defined in this Article (a multi-user entity with one or more independent sources of electric power and generation);[142] (3) a limit on the size of unregulated microgrids (with respect to number of participants and energy output) to prevent overly large projects from evading public utility status;[143] (4) a description of an application and registration process which would be administered by the state public utility commissions; and (5) the articulation of certain rights for microgrid owners (such as the right to net meter) and certain prohibitions on utility behavior (such as prohibiting them from

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[137] CA. ENERGY COMM'N PUB. INTEREST ENERGY RESEARCH, *supra* note 5, at 5 (explaining this concept).
[138] On a federal level, the American Clean Energy and Security Act (the Waxman-Markey bill), passed in June 2009, sets a target of four and a half percent of retail sales in 2012 and fifteen percent of retail sales in 2020 to come from renewable resources.
[139] FEDERAL ENERGY REGULATORY COMM'N, RENEWABLE POWER & ENERGY EFFICIENCY 4 (2010), *available at* http://www.ferc.gov/market-oversight/othr-mkts/renew/2010/01-2010-othr-rnw-archive.pdf.
[140] *Id.* at 7.
[141] *See*, *e.g.*, King & Morgan, *supra* note 99; King Regulatory Environment, *supra* note 86, at 11-13 (recommending specific regulatory changes).
[142] *See* King & Morgan, *supra* note 99, at 2 (suggesting that state laws include such a definition for microgrids).
[143] A reasonable size limit for an unregulated microgrid could be forty megawatts, which, as others have argued, would accommodate several users with different loads. *See* King & Morgan, *supra* note 99, at 2 (noting that peak loads for residential homes are ten to thirty kilowatts, for shopping centers two to eight megawatts, and for office buildings six to twenty megawatts).

refusing to serve microgrid customers).[144] In addition, key to any reform is a clear, fair system of tariffs imposed on microgrid operators and end users.[145] A bi-directional tariff that takes into account the needs and goals of the utility companies and the microgrid operators should be developed.[146]

Assuming that an acceptable model standard for microgrids will soon emerge, Congress should adopt a rule that requires states to consider it. Federal legislation of this nature can both respect states' autonomy and build on states' expertise. More broadly, such legislation would reflect political trends that support the creation of so-called "green jobs" and the move toward energy independence.

B. Siting Reform: Providing Guidance to Localities

Elsewhere, I have argued that states can, and should, become more involved in land use regulation in situations in which a broader policy goal that localities might not be inclined to consider could be advanced.[147] Because energy sprawl transcends local boundaries, individual localities may not understand, or may be inclined to ignore, the impact of their actions on areas outside their boundaries. They may reject microgrid technologies, taking a "not-in-my-backyard" approach that drives distributed generation projects outward.[148]

To combat such tendencies and clear a hurdle for potential microgrid operators, state legislatures should consider laws that provide special treatment to microgrid projects. At a minimum, they should modify the standard zoning enabling acts, which give localities their power to create and administer a system of regulating land uses, to say that zoning boards and local councils may not take any action that would unreasonably burden or halt microgrid projects, absent a compelling state interest that would

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[144] Utilities have great flexibility in applying tariffs and can relatively easily refuse service or change rates for operators of distributed generation technology or microgrids. *See* King Regulatory Environment, *supra* note 86, at 7.
[145] As another commentator has summarized, public utility tariffs are set (or should be set) with seven goals in mind: attracting capital for the utility, encouraging efficient management practices, promoting socially optimal consumer choices (preventing over- or under-consumption), ensuring fairness to investors, providing a stable and predictable rate level, encouraging efficient management and use of customer-generated resources, and compensating customers for services rendered to the utility. King Thesis, *supra* note 6, at 87-88.
[146] *See* Morgan & Zerriffi, *supra* note 82, at 6 (suggesting such a tariff and indicating that such tariffs "would depend on the size of the micro-grids, their number, and the nature of the distribution utility's system and loads").
[147] *See* Bronin, *supra* note 109.
[148] *See supra* text accompanying notes 110-114.

require such an action. States have passed laws of this nature to facilitate the siting of individual solar collectors, on the theory that localities may not necessarily consider the states' broader energy goals when making land use decisions.[149] Expanding this protection to microgrid projects more generally, while allowing localities to provide reasonable restrictions on such projects, would be worthwhile.

In addition, states could encourage local land use offices to develop fast-track permitting processes and special building codes for projects that utilize specific distributed generation technologies. Here too, state regulation could be implemented in such a way that local autonomy is respected. Finally, states could require localities to include microgrid siting as a mandatory element of their comprehensive plans. Many states require localities to draft comprehensive plans that take into account considerations such as affordable housing or open space. It would be entirely appropriate to ask them to take microgrids into consideration when devising land use plans for their communities.

CONCLUSION

Even alternative energy has costs. Energy sprawl, an unintended and harmful consequence of large-scale alternative energy projects, should become a more important concern for policymakers around the country. As this Article has shown, microgrids provide decentralized, flexible energy infrastructure that can be easily deployed in places already touched by human development. They can meet growing demand for energy without some of the negative consequences of larger (or, for that matter, smaller) energy projects. Congress should act quickly to require states to "consider" model microgrid standards, while the states should provide guidance to localities on siting microgrids. Removing some of the barriers to microgrid development, even in the incremental way advocated by this Article, could radically transform future patterns of land use.

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[149] Bronin, *supra* note 109, at 270-72 (describing state laws in California and Connecticut which take this approach).