WIND ENERGY IN MASSACHUSETTS: THE ROLE OF MUNICIPAL ELECTRIC UTILITIES

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Abstract

This thesis explores the decision by municipal electrical utilities in Massachusetts to make investments in wind energy. Using case studies with municipal electrical utilities, this research looks at the influence of community support, state and federal policies, and prices of fossil fuels on wind energy decisions. Community involvement and support are important factors for wind energy ownership by municipal utilities. Among municipal electrical utilities that do not own any wind energy generation, perceptions about low levels of community support for wind energy, the lack of compelling financial incentives, and low costs of conventional fuels were identified as barriers to wind energy. This research concludes that state and federal policies for renewable energy offer weak incentives to municipal electric utilities for wind energy, and that wind energy can be increased among municipal electric utilities through policies that are inclusive of municipal electric utilities. Further, participation in wind energy decisions by community members is a key component of successful wind energy projects.

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WIND ENERGY IN MASSACHUSETTS: THE ROLE OF MUNICIPAL ELECTRIC UTILITIES

CHAPTER 1: INTRODUCTION

In the past decade, wind energy has emerged as an important source of electricity generation. In the United States, wind energy increased from 24,651 megawatts (MW) in 2008 to 39,135 MW in 2010 and comprised 2.3 percent of total electricity generation.[1] Wind energy provides environmental benefits by offsetting electricity from fossil fuel sources, thereby reducing greenhouse gas emissions that contribute to climate change. Wind energy also offers benefits such as stable energy costs and "energy security" by reducing reliance on energy supplies imported from foreign counties. Further, wind energy provides economic benefits to communities through new jobs, decreased energy costs, revenue from selling surplus energy, and incentives paid by federal and state renewable energy programs. In this thesis I examine the development of wind energy by municipally owned electric utilities in Massachusetts. This research attempts to provide insight on the factors that influence wind energy projects to understand how to increase participation of municipal electric utilities in the development of new wind energy supplies.

First, I examine the current context of the development of wind energy projects by publicly (municipally) owned electric utilities (POUs) in Massachusetts.[2] Secondly, I use data from interviews with municipal light plant officials to understand drivers and

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[1] U.S. Energy Information Administration (EIA), "Wind," *Renewable and Alternative Fuels*, accessed June 26, 2012, http://205.254.135.7/cneaf/solar.renewables/page/wind/wind.html.

[2] Publicly Owned Utilities (POUs) differ from "Public Utilities" which is often used to describe Investor Owned Utilities (IOUs). In the former case, the utility is owned by a governmental entity such as a city, town, or state. In the latter case, the utility is a business organization, which provides a service considered a "utility", such as electricity, and is managed as a private enterprise.

barriers to wind energy ownership. Lastly, I provide policy recommendations for municipal light plants to promote the development of new wind energy generation.

POUs in Massachusetts are commonly referred to as "municipal light plants" or "municipal electric utilities", a name that goes back to their beginning as plants that generated electricity to light streets as well as private homes and businesses. Accordingly, publicly owned utilities are referred to as municipal light plants, utilities, and departments. However, most municipal light plants no longer operate generating plants, but rather own and maintain the transmission related infrastructure.[3] Electricity is purchased though the regional grid operator, ISO-NE, which is supplied by independent power producers (IPPs) throughout the New England Region.[4]

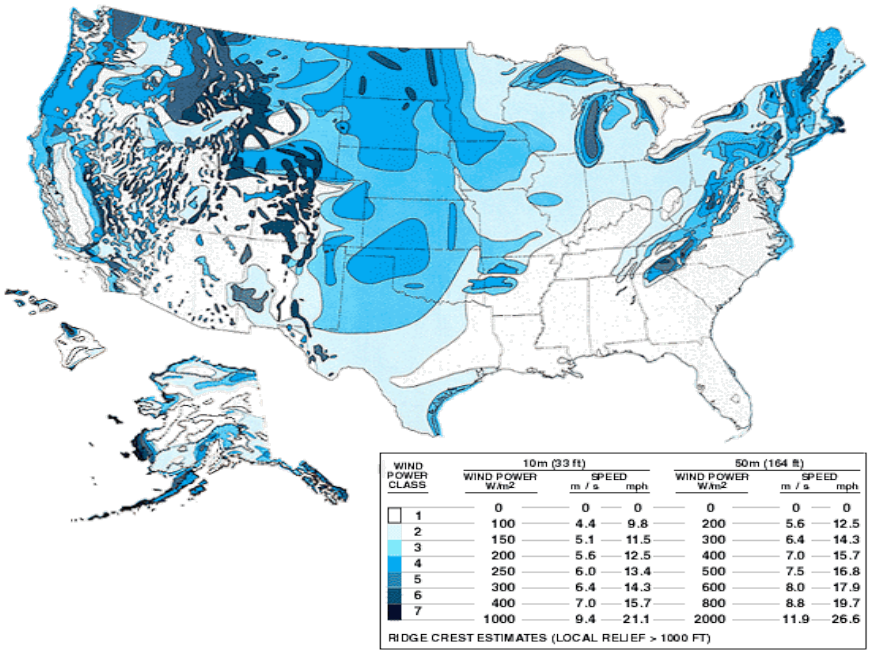
[3] Massachusetts Municipal Wholesale Electric Company, "2011 Annual Report," accessed July 27, 2012, http://www.mmwec.org/documents/annual-reports/2011_AR_PDF_for_web.pdf.

[4] Independent System Operator of New England (ISO-NE), "Markets," accessed July 27, 2012, www.iso-ne.com/markets/index.html.

CHAPTER 2: WIND ENERGY BACKGROUND

Massachusetts has set a goal for wind power of 2,000 MW before 2020 including wind energy from onshore and adjacent federal waters.[5] If met, this goal would represent approximately 10% of the state's electric load in 2012. Meeting this goal will require the construction of many new and larger wind power projects. The availability of wind power varies throughout the country and in Massachusetts as shown in Figure 1. Generally, onshore wind power in Massachusetts ranges 10 to 14 mph, or wind power Class 2 to wind power Class 5.

Figure 1: U.S. Average Annual Wind Power Map[6]

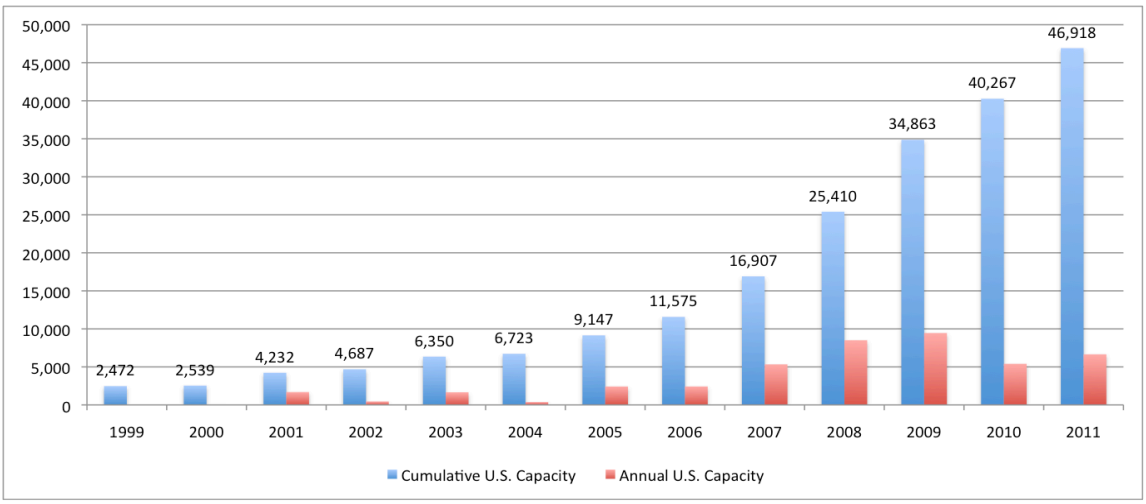


[5] Mass DOER, "Wind Energy in Massachusetts: 2,000 MW by 2020," *Renewable Energy Trust*, accessed November 15, 2010, http://www.mass.gov/eea/docs/doer/renewables/wind/wind-energy-ma-2020.pdf.

[6] U.S. Department of Energy, "Wind Turbines," *Energy Efficiency and Renewable Energy*, accessed November 15, 2010, http://www1.eere.energy.gov/tribalenergy/guide/wind_turbines.html.

The amount of wind energy produced nationwide has increased dramatically over the last decade. As shown in Figure 2, between 2010 and 2011 approximately 6,651 MW of new capacity was added to reach a cumulative total 46,918 MW.[7]

Figure 2: Annual and Cumulative Wind Energy Capacity in the U.S. 1999-2011 (MW)[8]

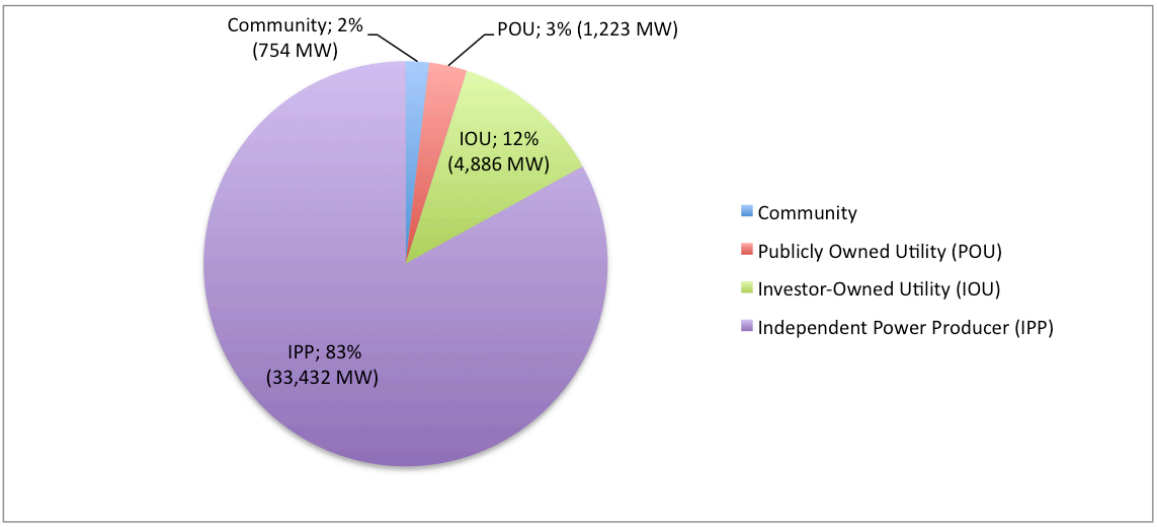


Despite the increase in wind energy over the past decade, wind energy ownership is largely concentrated in the hands of Independent Power Producers (IPPs) and IOUs. As shown in Figure 3, as of 2010 the IPPs owned 83% (33.4 GW) of all wind energy generation. IOUs were responsible for the second most wind energy with 12% (4.8 GW) and Publicly Owned Utilities and Community Owned Wind were responsible for 3% (1.2 GW) and 2% (0.75 GW) respectively.

[7] U.S. Department of Energy, "US Installed Wind Capacity by State", *Wind Powering America*, accessed July 2, 2012, http://www.windpoweringamerica.gov/wind_installed_capacity.asp.

[8] Ibid.

Figure 3: Cumulative and 2010 Wind Power Capacity by Owned Type [9]

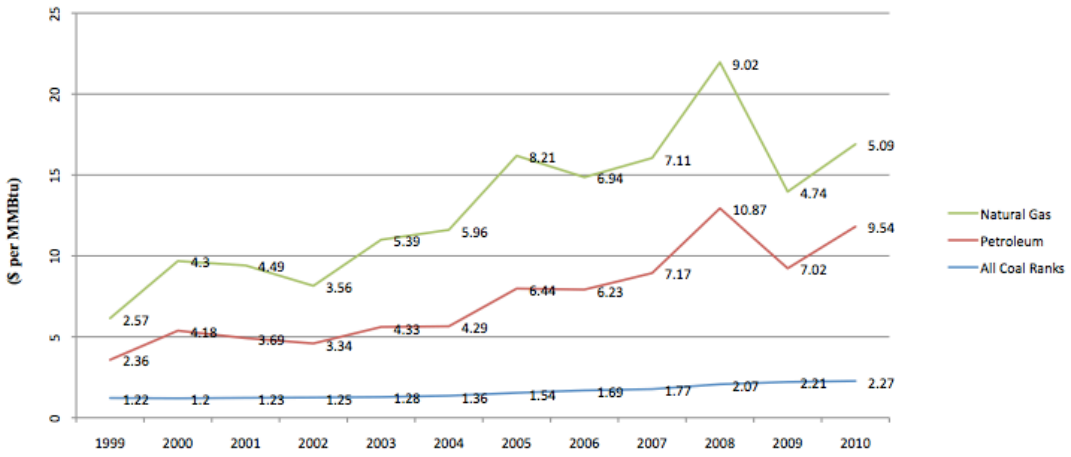


As of June 2012, approximately 61 MW of wind energy has been constructed in Massachusetts.[10] Several notable examples of wind energy projects include Hull, Princeton, Templeton, and the Berkshire Wind Cooperative, all of which have been developed by municipal electric utilities. Municipal light plants control approximately 24 MW of wind energy capacity or 39 percent of the total wind energy generation in Massachusetts. The success of municipal wind energy projects may be the result of greater public acceptance compared to investor owned projects. It is also possible that as a municipal entity, its structure allows customers, who are also owners, to influence the development of wind energy. These and other factors are the focus of the case studies presented in later chapters of the thesis.

[9] Ibid.

[10] Massachusetts Department of Energy Resources, "Renewable Energy," *Renewable Energy Snapshot*, accessed July 27, 2012, http://www.mass.gov/eea/energy-utilities-clean-tech/renewable-energy/renewable-energy-snapshot.html.

Figure 4: Fossil Fuel Costs for Electricity Generation[11]

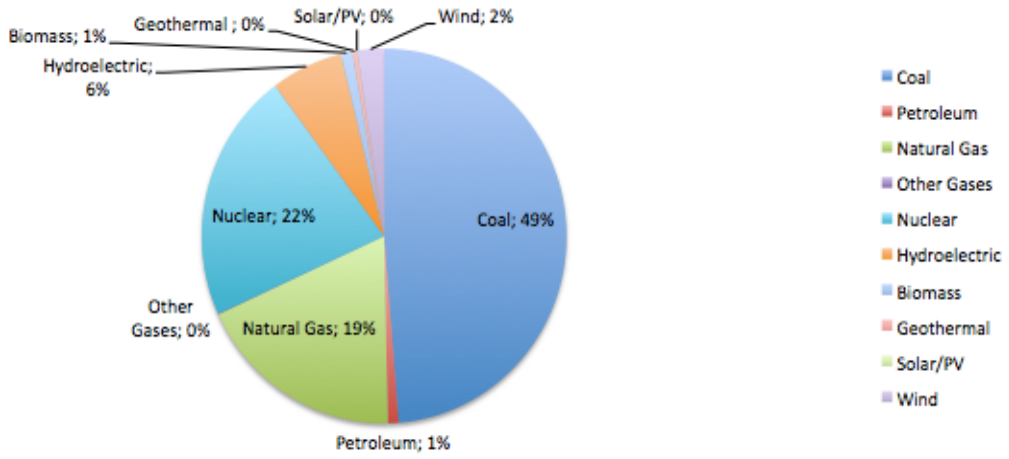


In addition, higher fuel costs for fossil fuel sources over renewable sources may increase the amount of support for renewable energy when fossil fuel costs are high. As shown in Figure 4, the cost of fuel from coal was approximately between $1 per MMBtu to $2 per MMBtu from 2000 to 2010. From approximately 2003 to 2008, natural gas prices rose from around $5 to over $9. In 2009, the cost of natural gas fell dramatically from around $9 to under $5, with the price rising to slightly over $5 in 2010.[12] The overall rise in the costs for fossil fuels from 2000 to 2010 has created an incentive for the development of renewable energy sources. However, the drop in prices from 2008-2009 resulted in uncertainty over the direction of fossil fuel prices that may have held back renewable energy projects.

[11] U.S. Energy Information Administration (EIA), "Annual Electric Power Industry Report," *Form EIA-861*, accessed July 27, 2012, http://www.eia.gov/cneaf/electricity/page/eia861.html.

[12] Ibid.

Figure 5: 2010 U.S. Electrical Power Industry Generation by Source[13]



The main fuel sources for electrical power are natural gas, coal, and nuclear as shown in Figure 5. Nationally, wind energy comprised only about 2% of the electrical supply in 2010.[14] In Massachusetts, the total share of electricity generation from wind power is 0.09 % of the total energy generation.[15]

Cape Wind

In Massachusetts, discussion about wind energy has been dominated by the proposed Cape Wind project. The Cape Wind proposal is an offshore wind farm in Nantucket Sound that would consist of 130 turbines capable of generating 420 megawatts of power from wind energy.[16] Average production for the project is approximately 174

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[13] U.S. Energy Information Administration (EIA), "Annual Energy Review," *Total Energy*, accessed July 27, 2012, http://www.eia.gov/totalenergy/data/annual/showtext.cfm?t=ptb0804b.

[14] Ibid.

[15] U.S. Energy Information Administration (EIA), "State Renewable Electricity Profiles," *Massachusetts Renewable Energy 2010 Total Energy*, accessed November 2, 2012, http://www.eia.gov/renewable/state/massachusetts

[16] Cape Wind Associates, "Project Overview," *Project at a Glance,* accessed November 8, 2012, http://www.capewind.org/modules.php?op=modload&name=Sections&file=index&req=viewarticle&artid=24&page=1

MW, or almost 75% of electricity demand for Cape Cod including Martha's Vineyard and Nantucket.[17] Given its large size, the Cape Wind project has acted to polarize opinion of wind energy in Massachusetts. The environmental benefits associated with the project have created support for it, while the large size and location have also led to opposition. Further, opposition may result from the higher cost of energy from the project compared to market prices for energy. The majority of energy produced by the project will be purchased by National Grid and NStar, two of the state's largest IOUs, and passed along to ratepayers for each respective utility. "NStar's contract with Cape Wind calls for the utility to pay 18.7 cents a kilowatt hour for the proposed Nantucket Sound wind farm's electricity, with a 3.5 percent escalator clause for each year of the contract."[18] National Grid has also contracted with Cape Wind to purchase half of the output at the same price as NStar.[19] In addition to the fixed price for the energy, the contracts also allow National Grid and NStar to charge their customers a fee of 4% of the contract's value.[20] While Cape Wind stands to dramatically increase the amount of wind energy produced in Massachusetts, it stands in contrast to a vision of wind energy that is smaller, distributed throughout the state, and is owned locally.

Electric Utilities in Massachusetts

There are three investor owned utilities in Massachusetts: National Grid, Unitil d/b/a "Fitchburg Gas & Electric", Northeast Utilities d/b/a "Western Massachusetts

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[17] Cape Wind Associates, "Cape Wind Basics", *Frequently Asked Questions,* accessed November 8, 2012, http://www.capewind.org/FAQ-Category4-Cape+Wind+Basics-Parent0-myfaq-yes.htm

[18] Bruce Mohl, "NStar pays big premium for Cape Wind power", *Commonwealth,* March 30, 2012, http://www.commonwealthmagazine.org/News-and-Features/Online-exclusives/2012/Winter/034-NStar-Cape-Wind-deal.aspx.

[19] Ibid.

[20] Ibid.

Electric Company" and "Nstar."[21] Investor owned utilities provide electricity to approximately 87% of customers statewide and the other 13% of energy consumers receive electricity from municipal electric utilities.[22]

Berkshire Wind Power Cooperative Corporation

At the time of this research, the Berkshire Wind Power Cooperative Corporation (BWPCC) operates the largest wind farm in Massachusetts. The project consists of 10, 1.5 MW wind turbines and generates enough electricity for 6,000 homes.[23] The project is located on Brodie Mountain in Hancock and consists of 14 municipal electric utilities and the Massachusetts Municipal Wholesale Electric Company (MMWEC).[24] MMWEC provided planning, construction, financing and operational services to the project. The project was financed with $64 million dollars in tax-exempt revenue bonds.[25] Since it became operational in May 2011, BWPCC will produce approximately 50,000 MWh/year, offset 612,000 metric tons of CO2 a year and 1.7 million barrels of oil a year.[26] BWPCC highlights the potential to increase wind energy using municipal utility ownership.

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[21] On April 2012, the Massachusetts Department of Public Utilities approved the merger of Northeast Utilities and Nstar. Nstar now operates as a subsidiary of Northeast Utitiles.

[22] Massachusetts Department of Energy Resources, "Municipal Utility Study: Technical Report," *Creating a Greener Energy Future for Commonwealth*, accessed July 8, 2012, http://www.lunenburgonline.com/education/district/district.php?sectionid=1.

[23] Berkshire Wind Power Cooperative Corporation, "Berkshire Wind Power Facts", accessed November 10, 2012, http://www.berkshirewindcoop.org/documents/DedicationFactSheetsPublisher.pdf

[24] Ibid.

[25] Ibid.

[26] Ibid.

Massachusetts Municipal Wholesale Electric Company (MMWEC)

The Massachusetts Municipal Wholesale Electric Company (MMWEC), established in 1969, is a non-profit, public corporation and political subdivision of Massachusetts that provides services to municipal utilities.[27] MMWEC provides power planning, tax exempt financing for energy projects, and energy purchases and sales among other services. MMWEC was also involved in the planning, financing, and construction of the Berkshire Wind Power Cooperative project for 14 of its member utilities. At the time of this research, 20 municipal utilities are members of MMWEC, and 28 are participants in power projects created by MMWEC.[28]

History of Municipal Light Plants

The first municipal light plant in Massachusetts was created by Danvers in1889 to provide lighting for municipal buildings and streets. Initially, it was not allowed to provide lighting to private residences, unlike private electric companies at that time, until it was ultimately granted the ability to do so by the Massachusetts legislature in 1891. In 1891, a bill was considered in the Massachusetts legislature to allow municipalities to establish their own light plants. The bill drew opposition from private electrical companies, who sought to keep the government out of the profitable electrical market that was developing. Opponents from the private companies testified before the legislature that,

> "We are now asked to take the first step towards surrendering the idea of individual enterprise, and giving over our industries to be managed by public

[27] Massachusetts Municipal Wholesale Electric Company, "What We Do," *Resource Development,* accessed November 2, 2012, http://www.mmwec.org/

[28] Massachusetts Municipal Wholesale Electric Company, "Who We Are", accessed November 2, 2012, http://www.mmwec.org/

> officers. Let them light our streets and supply our power; then let them run our street railroads, and absorb our telephones and telegraphs; let them gradually come into the management and control of all our quasi-public enterprises, and we shall have arrived at the goal of nationalism. What is "nationalism"? I understand it to be a theory of government which delegates as much as possible to the government, and leaves as little as possible to the individual –a theory which is thoroughly undemocratic, unrepublican, and un-American. And there is no disguise of the programme. Pending before this committee there are petitions for the enactment of a law to allow cities and towns to make light, and to engage in all other lawful business that the citizens of such cities and towns may desire to enter into…But was it not, Mr. Chairman and gentlemen, because our fathers objected to paternal forms of government, that they left their homes and crossed the sea to establish here new forms of government, to inaugurate new industries, and to lay the foundation of a success more glorious that was possible under old conditions?"[29]

The proponents of the legislation argued that the municipally owned light plants could provide better prices and service and noted the lack of competition that existed against private companies who controlled all electrical lighting for a community. A proponent of municipal light plants serving private customers testified,

> "that these companies as at present managed are practically monopolies, as it seems to me, but I do not intend to enter into any discussion of that matter. Practically there can be no competition with them. Now, I do not leery a monopoly. I say a properly regulated monopoly may be of great public service and of great public benefit: but that an unregulated monopoly is a public curse."[30]

The proposed legislation "turned into a bitter fight that lasted for twenty-six Committee hearings costing the private companies $15,000 in legal fees. The Town of Peabody, a

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[29] Everett W. Burdett, Attorney for the Massachusetts Electrical Lighting Association, testimony before the Massachusetts Legislature Committee on Manufactures, p. 26 March 23-24, 1891, accessed http://www.pmlp.com/against.html.

[30] Testimony of Forrest L. Evans, Testimony for the Massachusetts Legislature Committee on Manufactures, March 27, 1891, accessed http://www.pmlp.com/infavor.html.

proponent of the bill, spent $500 for their representation. The Committee on Manufacturing issued a split decision resulting in a majority report opposing the municipals' bill".[31] Despite the campaign waged against the legislation by the industry, on "June 4th, 1891…the Legislature and Governor approved the new statute…providing all cities and towns with the opportunity to establish their own electric business."[32] After the legislation was passed, the formation of municipal light plants took place throughout the state, with many of the original plants remaining today.

There are currently 41 municipal light plants as shown in Figure 6. MLPs provide electricity to 13% of customers and 14% of the electricity used.[33] All of the municipal utilities were formed prior to 1915, with the exception of the municipal utility formed in Devens in 1996.[34]

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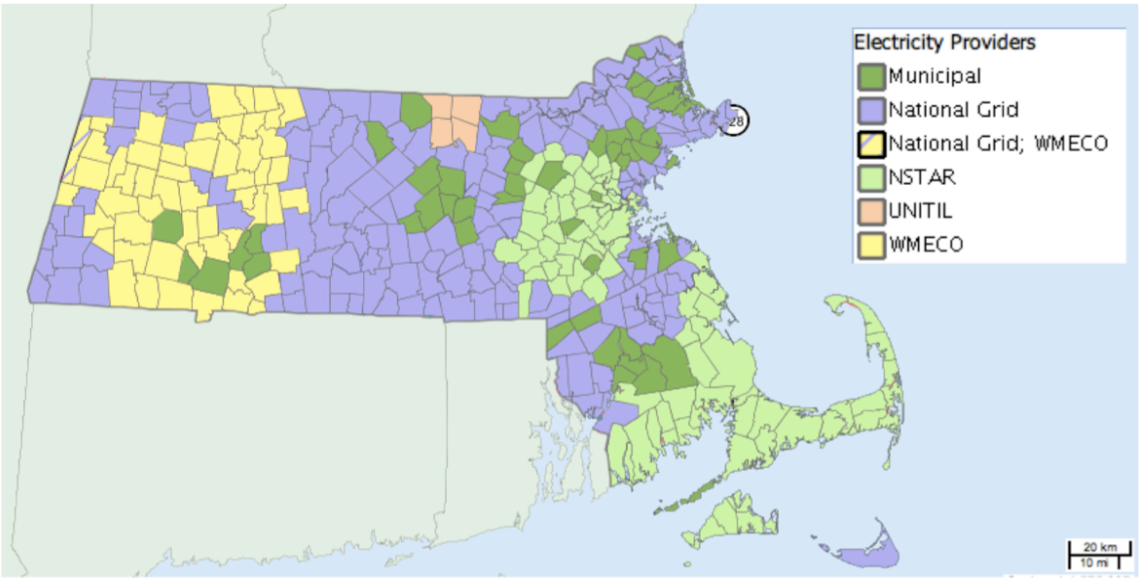
[31] Bruce Patten, "PMLP History," *Peabody Municipal Light Plant*, accessed July 9, 2012, http://www.pmlp.com/history.html.

[32] Ibid.

[33] Massachusetts Department of Energy Resources, "Municipal Utility Study: Technical Report" 2010, 13.

[34] Ibid.

Figure 6: Map of Municipal Electrical Utilities in Massachusetts[35]



Municipally owned electric utilities offer several benefits such as lower and more stable rates, higher reliability, and local control. In 2011, an average residential bill for 500 kWh for municipal utilities was $69 (the equivalent of 13.8 cents per kWh). For IOUs, the average residential bill was $98 for the highest price utility (Unitil), which is 42% higher than average cost of municipally owned utilities shown in Table 1.

Table 1: Average Monthly Residential Bill (500 kwh) for Municipal Utilities and Investor Owned Utilities[36]

	2004	2005	2006	2007	2008	2009	2010	2011
Fitchburg Gas & Electric (Unitil)	$69	$77	$101	$101	$105	$102	$98	$98
National Grid	$60	$66	$80	$83	$87	$82	$73	$70
Nstar	$66	$79	$103	$95	$100	$97	$86	$85

[35] Massachusetts Department of Executive Office for Administration and Finance, Office of Geographic Information (MassGIS), "The MassGIS Online Data Viewer and Editor," *Mass GIS's Online Mapping Tool*, accessed June 29, 2012, http://maps.massgis.state.ma.us/map_ol/oliver.php.

[36] Massachusetts Alliance for Municipal Electric Choice, accessed July 27, 2012, http://www.massmunichoice.org.

Northeast Utility (Western Mass Electric Co.)	$58	$64	$83	$88	$91	$87	$78	$79
Municipal Utility (Avg)	$52	$56	$62	$62	$69	$70	$70	$69

In addition, "local, or municipal, utilities were established to provide services to their communities and nearby customers at cost. Municipal utilities typically return a portion of their net income to consumers in the form of general funds transfer. Retail rates may be lower than neighboring investor-owned utilities because they are not subject to State and Federal income tax. Municipal utilities, as well as other publicly owned utilities, are able to issue low cost, tax exempt debt to finance construction."[37] These advantages over IOUs make municipally owned electric utilities an important participant in developing new renewable energy resources in a way that provides benefits to the community and ratepayers.

The benefits of municipal utilities over IOUs have resulted in renewed interest among communities served by IOUs in "municipalizing" their energy utility. As of 2011, legislation is pending that would make it easier for a town or city to municipalize its electricity utility.[38]

In Massachusetts, municipal utilities have successfully constructed several wind energy projects as shown in Table 2. These projects provide environmental benefits,

[37] U.S. Energy Information Administration (EIA), "Electric Power Industry Overview 2007," *Electricity*, accessed May 14, 2011, http://www.eia.gov/cneaf/electricity/page/prim2/toc2.html.

[38] General Court of The Commonwealth of Massachusetts, "An Act relative to the establishment of municipal lighting authorities," *Bill H. 869*, accessed July 16, 2012, http://www.malegislature.gov/Bills/187/House/H00869.

such as reduced GHG emissions and air pollution, and financial benefits from lower energy costs and more stable energy prices.

Table 2: Massachusetts Municipal Light Plant Wind Power Projects 2012[39]

Project	Owner	Date of Initial Operation	Capacity	Status as of 2012
Hull Wind I-II	Hull Municipal Light Plant	2001, 2006	Two-turbines 2.46 MW	Operating
Hull Wind Offshore	Hull Municipal Light Plant	n/a	Four 3-5 MW offshore turbines	Planning
Princeton Wind	Princeton Municipal Light Plant	2009	Two-turbines 3MW	Operating
Berkshire Wind Power Project	Owned by MMWEC and 14 Member utilities	2010	10-turbine, 15MW in Hancock, MA	Operating
Templeton Wind	Templeton Municipal Light Plant	2010	A single 1.65 MW turbine	Operating
Ipswich Wind	Ipswich School District and Ipswich Municipal Light Plant	2011	One 1.65MW turbine	Operating

As of July 2012, MLPs in Massachusetts have approximately 24 MW of wind energy power in operation or about 39 percent of the current amount of all operating wind energy capacity in Massachusetts.[40] Given the high percentage of wind energy projects developed by MLPs, the factors that promote their development, as well as the barriers, are of interest to policy makers. Further, the financial benefits from owning wind energy generating facilities are of interest as well. However, pressure to generate

[39] U.S. Department of Energy, "Wind Program," *New England Wind Projects*, accessed July 27, 2012, http://www.windpoweringamerica.gov/newengland/projects.asp.

[40] This figure was calculated from data from the Massachusetts Executive Office of Energy and Environments website, "*Wind Energy Projects*". As of June 2011, the approximate amount of wind energy in operation, based on name-plate rating, is 61 MW. Of that amount, 24 MW is operated by Municipal Electric Utilities, or about 39 % of the total amount. See *Appendix B* for a complete list of wind energy projects operating in Massachusetts.

energy from clean and renewable sources will come into direct challenge with the long-standing goal of providing electricity at low costs.

Ownership Options for Municipal Light Plants

Municipal light plants developing wind energy projects within their community generally purchase and own wind turbines through traditional municipal financing; however, municipal light plants can also obtain electricity through Power Purchase Agreements (PPA) with IPPs who own and operate wind energy facilities. The purchase of electricity from wind energy projects through a PPA has different benefits and drawbacks over direct ownership. A PPA has the following benefits to the purchaser of energy: no up-front capital costs; ability to monetize tax incentives; a known, long-term energy price; no operation or maintenance; and minimal risk.[41] On the downside, PPAs for public power utilities have the potential to "leave millions of dollars on the table…because the electricity prices in the power purchase agreements frequently ignore the impact of the credits and federal government subsidies available to the providers".[42] Yet, by " factoring subsidies into the PPA pricing formulae, municipal utilities might reduce their alternative energy costs by up to 20 percent".[43] The decision to pursue ownership or to purchase wind power in the form of PPA comes with potential benefits and risks that can be weighed to determine the value to the community served by the utility.

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[41] U.S. Department of Energy, "On-Site Renewable Power Purchase Agreements," *Project Funding*, accessed July 9, 2012, http://www1.eere.energy.gov/femp/financing/power_purchase_agreements.html.

[42] Jeffrey Hooke, "Alternative Energy Deals," *Public Power*, March-April 2011, vol. 69, No. 2, http://www.publicpower.org/Media/magazine/ArticleDetail.cfm?ItemNumber=31234.

[43] Ibid.

The trade-off between the benefits and costs of direct ownership of wind energy compared to a PPA from a non-utility generator (NUG)[44] is referred to as the "buy vs. build" debate.[45] The debate among individuals in the energy sector centers on the "relative advantage of, the types of risk created by, and the regulatory incentives favoring each approach."[46] Bolinger cites the possible economic advantages of publicly owned utilities in developing their own renewable energy projects as follows: "(1) the tax-free status of publicly owned utilities and the availability of low-cost debt, and (2) the renewable energy production incentive (REPI) available only to publicly owned utilities".[47] In contrast, by purchasing wind power from NUGs, utilities can benefit from the economic advantages provided to the NUG such as federal tax credits and accelerated depreciation, as well as state incentives that are not available to utilities.[48] The economic benefits would reduce the overall cost of the power purchase agreement between the NUG and the utility. Other ownership options, including ownership though a cooperative agreement, provide benefits such as reduced costs, risk, and economies of scale. The various ownership structures for wind energy may have an influence on the support from a community. Additionally, the willingness of a MLP to consider options to include wind energy in its electricity supplies may influence its participation in wind energy.

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[44] Non-Utility Generators are also referred to as "Independent Power Producers".

[45] Mark Bolinger, Ryan Wiser, and William Golove, "Revisiting the *Buy versus Build* Decision for Publicly Owned Utilities in California Considering Wind and Geothermal Resources," *Lawrence Berkley National Laboratory*, October 2001, http://eetd.lbl.gov/EA/EMP/.

[46] Ibid.

[47] Ibid.

[48] Ibid.

CHAPTER 3: STATE AND FEDERAL WIND ENERGY POLICY

State and federal policies have created incentives as well as requirements for renewable energy sources such as wind energy. These programs, including a discussion of their influence on municipal light plants, are detailed below.

Renewable Energy Production Incentive

The Renewable Energy Production Incentive (REPI) is a federal incentive for renewable energy produced by qualifying governmental entities. The REPI was created by the Energy Policy Act of 1992 and initially provided a 1.5-cents/kWh payment to qualifying facilities for the first 10 years of operation adjusted for inflation. The incentive is available to not-for-profit electrical cooperatives, public utilities, state governments, commonwealths, and native corporations.[49] It was reauthorized in 2005 as part of the Energy Policy Act of 2005 from 2006 to 2026 with a payment of 2.2 cents/kWh. While the program was reauthorized, the funding for the program needs to be appropriated annually by Congress. Since 2004 (production year 2003), the amount appropriated by Congress was not enough to cover 100% of the payments to qualifying Tier 1 projects as shown in Table 3.[50]

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[49] U.S. Department of Energy, "Renewable Energy Production Incentive," *Energy Efficiency and Renewable Energy,* accessed November 15, 2010, http://apps1.eere.energy.gov/repi/.

[50] Tier 1 qualifying facilities use wind, solar, geothermal, or closed-loop (dedicated energy crops) biomass technologies to generate energy. Tier II facilities use open-loop biomass (e.g., landfill methane gas, biomass digester gas, and plant waste materials).

Table 3: REPI payment amounts for qualifying Tier 1 facilities[51]

Year of Payment (FY)	Appropriated Funds	Tier 1 Paid	Tier 1 Unpaid	% Tier 1 Paid
1995	$693,120	$100,725	-	100%
1996	$2,398,472	$218,604	-	100%
1997	$2,490,893	$195,902	-	100%
1998	$2,853,997	$154,504	-	100%
1999	$4,000,000	$122,167	-	100%
2000	$1,500,000	$603,182	-	100%
2001	$3,991,000	$1,339,377	-	100%
2002	$3,787,000	$1,365,846	-	100%
2003	$4,815,033	$1,810,911	-	100%
2004	$3,714,911	$3,714,911	$1,091,206	77%
2005	$4,960,000	$4,960,000	$2,205,009	69%
2006	$4,925,375	$2,955,225	$6,323,364	60%
2007	$4,900,000	$2,940,000	$8,149,897	60%
2008	$4,500,000	$2,700,000	$11,252,558	60%
2009	$4,500,000	$2,384,470	$4,893,286	33%

According to data available on the REPI program webpage as of June 2012, from 2007 and earlier, Hull MLP was the only recipient of REPI payments in Massachusetts.[52] The REPI payments received by Hull are listed in the table below.

Table 4: REPI payments to the Hull Municipal Light Plant

Year	Facility	Payment	Total kWh Produced	Cents/kWh
2003	Hull Wind Turbine	$35,876	2,578,552	1.39
2004	Hull Wind Turbine	$27,438	1,545,522	1.78
2005	Hull Wind Turbine	$11,633	1,439,587	0.81
2006	Hull Wind Turbine #1	$7,901	1,611,046	0.49

[51] U.S. Department of Energy, "Renewable Energy Production Incentive," *Energy Efficiency and Renewable Energy,* accessed November 15, 2010, http://apps1.eere.energy.gov/repi/about.cfm.
[52] Information on the REPI program is not available online beyond 2009.

2006	Hull Wind Turbine #2	$5,496	1,120,649	0.49
2007	Hull Wind Turbine #1	$6,683	1,598,896	0.42
2007	Hull Wind Turbine #2	$16,015	3,831,658	0.42

Payments to Hull, for its Hull Wind Turbine #1, declined from 1.39-cents/kWh in 2003 to 0.42-cents/kWh in 2007. In 2004 Hull received a REPI payment of $27,438 for the 1,545,522 kWh produced by Hull Wind #1. Due to a decline in appropriations for the REPI program, in 2007 Hull received a payment of $6,683 for 1,598,896 kWh.

On the U.S. DOE website, it states "Annual REPI incentive payments are subject to availability of appropriated funds. DOE can make no commitment for payment of REPI incentives beyond the funds obligated in each fiscal year".[53] Payment amounts to Hull MLP since 2005 have not been sufficient to provide a 100% REPI incentive payment.

Clean Renewable Energy Bonds

The Clean Renewable Energy Bonds (CREBs) is a federal program that provides low-cost financing for qualifying renewable energy projects for governmental bodies, electrical cooperatives, and public power providers.[54] The program, administered by the Internal Revenue Service (IRS), works by having the federal government lower "the cost of debt by providing a tax credit to the bondholders in lieu of interest payments for the

[53] U.S. Department of Energy, "Renewable Energy Production Incentive," *Energy Efficiency and Renewable Energy,* accessed November 15, 2010, http://apps1.eere.energy.gov/repi/about.cfm.

[54] National Renewable Energy Laboratory, "Financing Public Sector Projects with Clean Renewable Energy Bonds," *Energy Analysis*, accessed November 15, 2010, http://www.nrel.gov/docs/fy10osti/46605.pdf

issuer…the investor receives a tax credit from the U.S. Department of the Treasury rather than an interest payment from the issuer."[55]

A potential drawback to using CREBs is that "in many cases the tax credit provided to investors has been insufficient and investors have required issuers to pay supplemental interest payments or issue bonds at a discount".[56] Also, "several challenges might make financing with CREBs difficult for public agencies. Deadlines for issuing bonds, reimbursing project costs, and spending all available proceeds are tight."[57] Further, the "high cost and complexity of issuing CREB can drive up overall financing costs for projects. Some public agencies (municipal utilities and governments) have cited high transaction costs as a barrier to issuing CREBs. Applying for and issuing CREBs requires considerable up-front legwork. These costs are relatively independent of project size and include the labor required to submit an application and issue the bond, any legal fees, and the costs associated with voter approval."[58] Table 5 includes examples of the amount of CREBs allocated to MLPs in 2009.

[55] Ibid.
[56] Ibid.
[57] Ibid.
[58] Ibid.

Table 5: 2009 CREB Allocations to Municipal Light Plants in Massachusetts[59]

Issuer Name	Project Type	Project City	State	Allocation
Massachusetts Municipal Light Department of Wind Energy Cooperative Corporation	Wind	Princeton	MA	$7,300,000
Town of Chester	Wind	Chester	MA	$2,100,000
Chicopee Municipal Light Plant	Wind	Russell	MA	$2,499,000
Russell Municipal Light Department	Wind	Russell	MA	$2,499,000
Westfield Gas & Electric Light Department	Wind	Russell	MA	$2,499,000

In 2009, the Princeton Municipal Light Plant was awarded $7,300,000 in CREB funding. However, the light plant did not ultimately use the CREBs that were allocated for its project. Other MLPs to receive CREBs were Chester, Chicopee, Russell, and Westfield Gas & Light. In Table 6 below, the allocation amounts to MLPs in 2007 are shown.

Table 6: 2007 CREB Allocations to Municipal Light Plants in Massachusetts[60]

Issuer Name	Project Type	Project City	State	Allocation
Ipswich Public School	Wind	Ipswich	MA	$1,600,000
Town of Chester	Wind	Chester	MA	$2,116,000
Mass. Municipal Wholesale Electric Co. (Berkshire Wind)	Wind	Ludlow	MA	$2,116,000

[59] Internal Revenue Service, "New Clean Renewable Energy Bonds – 2009 Allocations," *Public Power Providers*, accessed March 11, 2011, http://www.irs.gov/pub/irs-tege/ncrebs_2009_allocations_v1.1.pdf.

[60] Internal Revenue Service, "2007 Disclosure of Allocations," *Public Power Providers*, accessed March 11, 2011, http://www.irs.gov/pub/irs-tege/creb_2007_disclosure.pdf.

CREBs are one possible source of financing for municipal light plants.

The Massachusetts Renewable Portfolio Standard

The Massachusetts Renewable Energy Portfolio Standard (RPS) is a statutory requirement for retail energy suppliers (both distribution and competitive suppliers), to obtain a percentage of their energy from renewable and alternative energy sources. In 2003, the RPS began at 1 percent, increasing by 0.5 percent per year until it reached 4 percent by 2009. The Green Communities Act of 2008 created new requirements broken out by Class I and Class II and a new requirement for the annual obligation to increase by 1 percent a year.[61] Municipal electrical utilities are exempt from meeting the requirements of the RPS; however, they are able to participate in the sale of renewable energy certificates (RECs) if they own qualifying renewable energy generating facilities.

Electricity suppliers are required to meet the annual RPS obligation by buying RPS qualified RECs from qualifying renewable energy facilities throughout the ISO New England (ISO-NE). One MW of generation from a renewable source is given one REC. For 2010, the RPS Class I requirement is five percent, increasing by one percent each year without any limit. Qualifying RPS Class I renewable energy projects include: solar photovoltaic; solar thermal electric; wind energy; small hydropower; landfill methane and anaerobic digester gas; marine or hydrokinetic energy; geothermal energy; and eligible biomass fuel.

RPS Class II requires that electricity suppliers purchase a certain amount of electricity produced by eligible resources including sun, wind, ocean, landfill gas,

[61] General Court of The Commonwealth of Massachusetts, "An Act Relative to Green Communities," *Session Laws*: *Acts of 2008: Chapter 169*, accessed July 16, 2012, http://www.malegislature.gov/Laws/SessionLaws/Acts/2008/Chapter169.

hydropower, and geothermal that were in operation prior to 1998. This incentive is provided to operators to continue to run these generation facilities. The RPS in Massachusetts also provides incentives for the continued operation of pre-1998 waste to energy generation facilities. These regulations have been further amended to provide additional incentives for solar facilities that were operational after 2008 known as the "RPS Class I Solar Carve-Out" and corresponding SolarRECs.

In addition to buying RECs to meet obligations, the law also allows electricity suppliers to purchase alternative compliance payments (ACPs), and to bank surplus RECs from a previous year to meet compliance in a future year. As noted in DOER's annual report for the RPS program, the "total supply of electricity from RPS Class I Generating Units (represented by RECs) exceeded demand in 2009 for the third consecutive year…The 2009 RPS Class I obligation for each Supplier was four percent (4%) of its retail load…The total retail load obligation in 2009 was 48,301,821 MWh for which the 4% obligation was 1,932,089 MWh. The total Class I REC supply was 2,319,753…The 2,319,753 MWh total yielded a surplus of 387,664 MWh, of which 386,059 were eligible to be banked for compliance use in 2010 in 2011".[62] This surplus resulted in "low REC prices during the 2009 REC trading year".[63] Since the RECs are a market-based incentive, the surplus of RECs has driven prices paid to wind energy generators down, thereby decreasing the expected incentive from this program.

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[62] Massachusetts Department of Energy Resources, "Massachusetts Renewable and Alternative Energy Portfolio Standards (RPS & APS): Annual Compliance Report for 2009," *Executive Office of Energy and Environmental Affairs*, January 11, 2011: 8, www.mass.gov/eea/docs/doer/rps/rps-and-aps-2009-annual-compliance-report-doer-20311.pdf.

[63] Ibid.

Massachusetts Green Communities Program

The Massachusetts Green Communities Act[64] created the Green Communities Grant Program in 2008. It also created the Green Communities Division in the Department of Energy Resources (DOER). The Green Communities Division provides guidance and technical support for cities and towns on energy efficiency and renewable energy. The Act creates incentives for renewable energy, including wind energy, through net-metering requirements for IOUs.[65] "The state's investor-owned utilities must offer net metering. Municipal utilities are not obligated to offer net metering, but they may do so voluntarily."[66]

For communities with MLPs, allowing net metering community-wide, means that the MLP must buy energy from third parties at potentially higher rates than their own projects. This may serve as a disincentive for communities with MLPs from joining the Green Community program. However, MLPs can create their own net metering policies and have rates adopted by the Massachusetts Department of Public Utilities that provide incentives for renewable energy projects on beneficial terms to the utility.

Massachusetts Renewable Energy Trust

The Massachusetts Clean Energy Center (MassCEC) runs the Renewable Energy Trust Fund (RET), which was created as a part of the 1997 electric utility restructuring,

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[64] General Court of The Commonwealth of Massachusetts, "An Act Relative to Green Communities," *Session Laws*, Acts of 2008, chapter 169, Accessed July 16, 2012, http://www.malegislature.gov/Laws/SessionLaws/Acts/2008/Chapter169.

[65] Net metering is an electricity policy that provides customers of a utility who own renewable energy generation facilities, such as solar panels or wind turbines, with a retail credit for a portion of electricity that is not used on site and supplied back into the grid.

[66] U.S. Department of Energy, "Net Metering," *Database of State Incentives for Renewables and Efficiency,* accessed March 11, 2011, http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=MA01R&re=1&ee=1.

and recently updated by the Green Communities Act in 2008. The RET is funded by a 0.5 mil/kWh surcharge applied to the electricity sales to customers of all investor-owned electric utilities and competitive municipal utilities in Massachusetts.[67] Since the customers of MLPs are exempt from paying the surcharge, customers served by the utility, as well as the utility itself, are not eligible for grants from the RET Fund unless they voluntarily adopt the surcharge for their community. As of 2012, only five MLPs have joined the Renewable Energy Trust Fund as shown in Table 7.

Table 7: Municipal Light Plants in the Massachusetts Renewable Energy Trust Fund[68]

Municipal Light Plant	Effective date of Participation in Mass RET
Ashburnham	7/1/2009
Holden	9/1/2009
Holyoke	8/10/2009
Russell	10/1/2009
Templeton	6/1/2009

The fund provides grants to qualifying renewable energy projects. On its website, the CEC states

> the [Green Communities] Act prohibits Trust funding for projects in MLP territories unless: The mandatory charge for MassCEC's Renewable Energy Trust fund is collected by the MLP and remitted to MassCEC. MassCEC's Board of Directors determines that the grant, loan or subsidy, is intended for the principal purpose of generating public benefits for customers that do pay into the Trust, and will generate only incidental private benefits to the recipient, and the supported project provides unique or extraordinary opportunities to advance the public purpose of the Trust.[69]

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[67] Ibid.

[68] Massachusetts Clean Energy Center, "Municipal Lighting Plant Communities," *Renewable Energy Generation*, accessed November 15, 2010, http://www.masscec.com/index.cfm?cdid=11387&amp%3Bpid=11163.

[69] Massachusetts Clean Energy Center. "Municipal Light Plant Participation in the Renewable Energy Trust," *Renewable Energy Generation*, accessed July 1, 2012, http://www.masscec.com/index.cfm?cdid=11251&pid=11160.

While MLPs are exempted from paying into the RET, some municipal light plants have decided to join the RET. Since the decision to join the RET is irrevocable, this may act as a barrier to MLPs participating in the program.

Regional Green House Gas Initiative (RGGI)

The Regional Green House Gas Initiative (RGGI) is a compact among ten Northeast and Mid-Atlantic States[70] that uses a market-based "cap-and-trade" approach to reduce carbon dioxide (CO2) emissions released by fossil fuel fired power plants in the region.[71] In 2009, RGGI required emissions from the ten states to stay at or below 188 million tons and requires emitters to have permits to cover their emissions (at a rate of one permit for one ton of CO2 emissions). Between 2009 and 2014, emissions are "capped" at 188M tons. Between 2014 and 2018, the "cap" on total emissions will be lowered by 2.5 percent per year for a total decrease of 10% by 2018. Each state voluntarily joined RGGI by signing a non-binding memorandum of understanding and adopting laws based on RGGI's model rules.

From 2008 through 2010, RGGI held auctions for emissions in Massachusetts, which generated proceeds of $123,229,478.[72] Of this funding, Massachusetts, allocates 89% to energy efficiency, 9.3% to Renewable Energy, and 1.7% to program

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[70] The ten states currently participating in RGGI are: Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, Vermont. The state of Pennsylvania, and the Canadian provinces of Ontario, New Brunswick, and Quebec have also signed on as "observers." http://rggi.org/states/ten_states

[71] RGGI only applies to power plants with at least 25MW of generating capacity.

[72] Regional Greenhouse Gas Initiative (RGGI), "Investment of Proceeds from RGGI CO2Allowances," *Report Highlights Economic Benefits of RGGI CO2 Auction Investments*, February 28, 2011, http://www.rggi.org/docs/Press_Release_%20RGGI_Proceeds_Report.pdf.

administration.[73] The Green Communities Act requires the State's four IOUs and the Cape Light Compact (a municipal electric aggregator[74]) to reduce energy use among their customers. Approximately 10 million dollars from the auction proceeds are used annually to fund renewable energy grants under the Green Communities Program.

For the most part, municipal light plants are not eligible for this funding because few have joined the Massachusetts RET (a requirement to receive this funding). Although the cost of electricity that MLPs purchase from the regional market is affected by the RGGI surcharge, they are not eligible to receive the funding. This has limited the potential funds for municipal light plants for renewable energy projects.

The Massachusetts Global Warming Solutions Act

The Global Warming Solutions Act (GSWA) requires the State of Massachusetts to reduce greenhouse gas emissions.[75] The law requires the Executive Office of Energy and Environmental Affairs (EEA), and other state agencies to create a greenhouse gas emission reduction goal for Massachusetts.[76] The following greenhouse reduction goals have been established by the GWSA:

- Greenhouse gas emission levels 25 percent below statewide 1990 GHG emission levels by 2020.

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[73] Ibid.

[74] Municipal Electric Aggregation – Is the method by which local governments can buy electric power for consumers within their borders. The aggregate electrical loads of these consumers are used to negotiate more favorable terms and rates.

[75] General Court of The Commonwealth of Massachusetts, "Climate Protection and Green Economy Act," *Chapter 21N,* accessed July 16, 2012, http://www.malegislature.gov/Laws/GeneralLaws/PartI/TitleII/Chapter21N.

[76] Massachusetts Department of Environmental Protection, "Overview of the Global Warming Solutions Act," *Air and Climate*, accessed July 9, 2012, www.mass.gov/dep/air/climate/gwsa.htm.

- 80 percent below statewide 1990 GHG emission levels by 2050.

While the GWSA does not create a direct incentive for wind energy, the overall goal to reduce greenhouse gas emissions creates a policy and regulatory environment that favors renewable energy sources including wind energy.

CHAPTER 4: WIND ENERGY LITERATURE REVIEW

Previous studies on wind energy were reviewed to identify the relevant factors that influence wind energy. Of particular interest to this study is the role of community ownership on wind energy development and the barriers and incentives that exist for community ownership of wind energy.

Literature has previously focused on how wind energy can support a smaller community scale energy infrastructure where community ownership is more common. Szarka found that "one of the alleged benefits of some type of renewable energy technology has that it was likely to be more amenable to local democratic control than preceding large-scale centralized technologies".[77] This local control not only can decide where energy sources are built, but also how much is built, and how the benefits are used. When local "control" is absent, such as with large national and international IOUs, financial costs/benefits may be met with greater skepticism and slowing the deployment of new wind energy sources. Devine-Wright found that in the U.K., "high levels of public support for both economic and political aspects of local involvement in wind farm development…over 80% of respondents indicated that energy from wind farms should be used locally and that profits should be shared with local people".[78] Further, that "local involvement…tends to a have positive effect on public perceptions of wind farms and

[77] Joseph Szarka, "Wind Power, Policy Learning and Paradigm Change," *Energy Policy* 34, no. 17 (2006): 3047, accessed July 12, 2012, http://www.sciencedirect.com/science/article/pii/S0301421505001503.

[78] Patrick Devine-Wright, "Beyond NIMBYism: Towards an Integrated Framework for Understanding Public Perceptions of Wind Energy," *Wind Energy* 8, (2005): 133.

reflects growing interest in a 'soft path' emphasizing 'community' aspects of renewable energy development".[79]

Publicly owned utilities "allow for greater control and input by residents into utility investment and policy decisions. Unlike IOUs, the utility is owned and controlled by the municipality, over which residents can exercise a much greater level of control".[80] Publicly owned utilities may be able to use renewable energy to meet the community needs, or "social" issues. Mendonca, Lacey, and Hvelplund state, "the distributed nature of renewable energies offers an entirely different set of social and economic benefits than do fossil energies. Taking full advantage of these benefits will require…policies that can induce the participation of as many Americans as possible".[81] Ultimately, if more individuals participate in wind energy development through various forms of community ownership, then it may result in a more equitable, and socially just allocation of benefits, and thus a greater acceptability of wind energy. Social acceptance of wind energy has become important, as ambitious goals for increasing wind energy generating capacity have been adopted both nationally and in Massachusetts in response to the threats posed by climate change.

Mendonca et al. also argue that beyond adding wind energy capacity, "spreading the wealth within local communities, maximizing job growth, enriching the energy experience and empowering citizens is a part of the broader U.S. energy framework".[82]

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[79] Ibid.

[80] Massachusetts Department of Energy Resources, 2010. *Municipal Utility Study: Technical Report.*

[81] Miguel Mendonca, Stephen Lacey, and Frede Hvelplund, "Stability, Participation, and Transparency in Renewable Energy Policy: Lessons from Denmark and the United States," *Policy and Society* 27, no. 4 (2009): 379-398, accessed July 16, 2012, http://www.sciencedirect.com/science/article/pii/S144940350900006X.

[82] Ibid.

Other studies have also concluded that the "ability of community wind projects to disperse economic impacts within the states and communities where they are built and to engage local community members in the project could provide a valuable strategy for building community support of wind power especially in communities that are new to wind power".[83]

Federal incentives, such as production tax credits (PTC), have mainly benefited large corporations and investors with significant tax liabilities.[84] This type of policy incentive for wind energy has shifted the benefits of renewable energy such as wind energy towards large corporations. Policies that favor corporations over communities are not compatible with a sustainable development approach that may be important for developing more locally controlled and owned sources of wind energy. Szarka notes that "SD [sustainable development] concept rests on 'three pillars' – economic growth, environmental protection and social development – which are conceived as non-contradictory goals. Social development involves the reduction of poverty, social exclusion and injustice, and the promotion of community involvement in decision making".[85] Further, Szarka argues "as part of a new 'social contract' the public can demand that the benefits of improved efficiency and renewable energy flow back to them. Indeed, cutting escalating energy bills is one strong reason for making these demands; another is making a contribution to climate change protection that matters. In the energy

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[83] Eric Lantz and S. Tegan, "Economic Development Impacts of Community Wind Projects: A Review and Empirical Evaluation," (presentation, Windpower 2009 Conference and Exhibition, Chicago, Illinois, May 4-7, 2009).

[84] Joseph Szarka, "Wind Power, Policy Learning and Paradigm Change," *Energy Policy* 34, no. 17 (2006): 3041-3048, accessed July 12, 2012, http://www.sciencedirect.com/science/article/pii/S0301421505001503.

[85] Joseph Szarka, *Wind Power in Europe*: *Politics, Business and Society*, (New York: Palgrave Macmillan, 2007), 11.

sector as elsewhere, an active and involved citizenry is perhaps the only way to make sustainable development a reality".[86]

Toke found that the "local perception of the economic impact of the scheme on the locality is also an especially crucial variable".[87] Similarly, Mendonca et al. states "local acceptance is central to successful deployment of wind power…The fact that wind turbines are turning in your local area means money being generated for local people has a powerful effect on behavior and attitudes".[88]

The findings in this research build upon previous research by looking at the role of municipal utilities on development wind energy.

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[86] Ibid., 199.

[87] Dave Toke, "Explaining Wind Power Planning Outcomes: Some Findings from a study in England and Wales," *Energy Policy* 33, no. 12 (2005): 1539, accessed July 16, 2012, http://www.sciencedirect.com/science/article/pii/S0301421504000175.

[88] Mendonca, M., Lacey, S., Hvelplund, F. 2009, p. 16.

CHAPTER 5: RESEARCH METHODOLGY

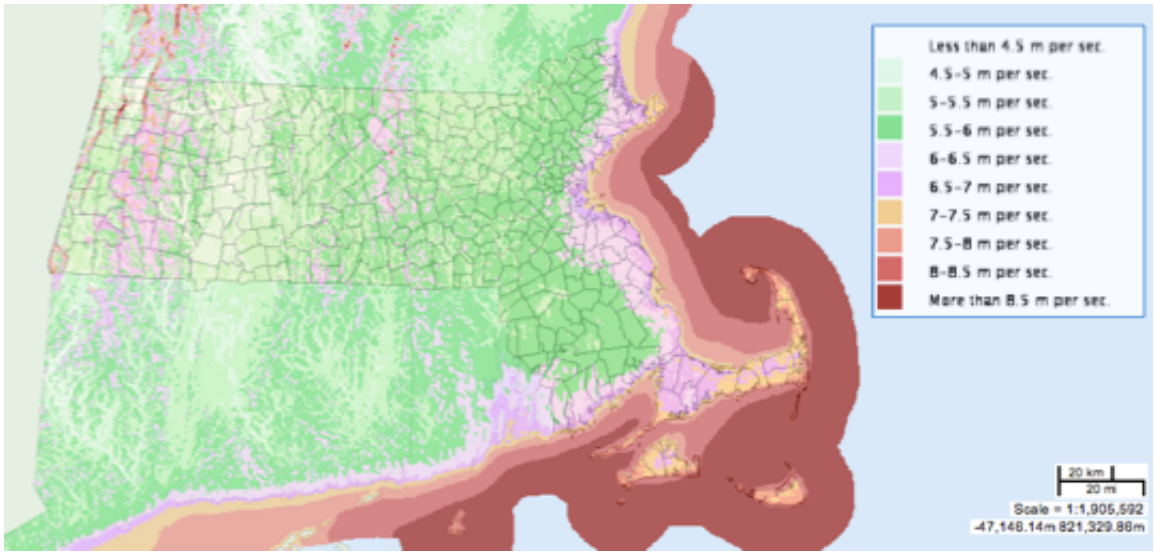
This research uses a case study approach to systematically collect and analyze data in order to see connections and make predictions about factors that promote wind energy development by municipal electric utilities. Since this research is interested in how and why some municipal light plants have pursued wind energy, while others have not, the case-study approach is most appropriate.[89] A case study allows for an in-depth and detailed review of wind energy projects, reasoning, interests, community involvement, and other factors that have influenced decisions regarding wind energy projects. Open-ended interviews with municipal light plant officials are the primary source of information for each case study. The interview guide attached in Appendix A contains the questions used during interviews. In addition, information from interviews is supplemented by information available over the Internet such as reports, surveys, presentations, and newspaper articles.

Listed in Table 8, eighteen communities fit the case study criteria from the 41 communities with municipal light plants in Massachusetts. The criteria for a case study require that a community have wind speeds to support a utility-scale wind turbine (average annual wind speeds above 5 m/s (12 m/h) at 80 meters). A total of 18 communities had sufficient wind resources for utility-scale wind energy as shown on the wind resources map in Figure 7. Wind resources may be higher or lower than those predicted by a wind resources map at a specific site. Therefore, municipal light plants in communities mapped with lower average annual wind speeds may still contain sites that would support utility-scale wind turbines. Table 8 shows that the communities exhibiting

[89] Yin, Robert K. Applications of case study research. London: SAGE, Publications, 2012.

higher than average wind resources are located along the northeastern coast (e.g. Ipswich, Danvers, Georgetown, Marblehead, Peabody, Middleton), southeastern coast (e.g. Hull, Hingham), and western portions of the state (e.g., Ashburnham, Paxton, Templeton, Chester, Princeton).

Figure 7: Modeled Wind Speeds in Massachusetts (70M)[90]



Other characteristics for each community fitting the case study criteria were explored to understand commonalities and difference between communities. One community characteristic potentially supportive of wind energy is the presence of environmental groups and organizations such as International Council for Local Environmental Initiatives (ICLEI) and the Mass Climate Action Network (MCAN). Participation in MCAN gives community assistance with climate action plans, municipal

[90] Massachusetts Department of Executive Office for Administration and Finance, Office of Geographic Information (MassGIS), "The MassGIS Online Data Viewer and Editor," *Mass GIS's Online Mapping Tool*, accessed June 29, 2012, http://maps.massgis.state.ma.us/map_ol/oliver.php.

resolutions, and energy committees.[91] Wind energy is one way to achieve the goals that these groups have for reducing emissions that contribute to climate change. It is possible that communities with active environmental groups may place a higher value on the environmental benefits of wind energy.

In addition to environmental benefits, wind energy offers economic benefits, such as lower and more stable electricity prices. As a result, communities with above average electricity rates may be supportive of wind energy projects that result in lower electricity rates or other savings to the ratepayers in that community. However, higher than average electricity rates might affect a community's willingness pursue a wind energy project if prices for electricity will rise in the short-term.

[91] Massachusetts Climate Action Network, "Local Groups and Partners," *Local Groups*, accessed November 15, 2010, http://massclimateaction.net/chapters/chapter-list.html.

Table 8: Characteristics of Communities fitting the Criteria for Case Studies

	Avg Annual Wind Speed (m/s)	Wind Power Project or Planned	Climate Change	Environ mental Justice	Persons/Sq. miles (Less dense indicated by shading)	2008 Rates (13.34 average) per kWh	Per Capita Income (1999) < $25,900
Town of Ipswich	6.5	√	√		412	14.9	32,516
Town of Hull	6.5	√	√		3671	12.42	26,331
Town of Rowley	6.5				311	12.88	27,413
Town of Marblehead	6.5				4407	14.66	46,738
Town of Paxton	6				328	14.12	29,573
City of Hingham	6		√		1036	14.02	41,703
Town of West Boylston	5.5			√	629	14.02	22,899
Town of Holden	5.5		√		505	15.08	27,971
Town of Georgetown	5.5				674	15.25	28,846
Town of Princeton	5.5	√			99	17.23	32,232
Town of Chester	5.5	√			36	12.55	18,098
Town of Ashburnham	5.5	√			157	13.22	21,659
Town of Templeton	5.5	√			249	12.51	21,994
City of Peabody	5.5			√	3154	11.24	24,827
Town of Braintree Electric Light Dept.	5.5				2539	15.16	28,683
Town of Middleton	5.5				661	10.68	29,031
Town of Shrewsbury	5.5			√	1639	10.33	31,570
Town of Danvers	5.5				2051	11.14	26,852

Shaded rows indicate case study communities

Table 8 shows characteristics of communities, including higher than the average electricity rates (Princeton, Georgetown, and Holden), and those with lower than average electrical rates (Danvers, Peabody, Shrewsbury, and Middleton). These characteristics

show the commonalities and differences between communities that may influence wind energy decisions.

Officials from eight light plants of the possible 18 communities meeting the study's criteria responded to requests for interviews. Interviews were conducted between November 2010 and January 2011 in person and by telephone. Interviews were conducted using the interview guide contained in Appendix A. A semi-structured interview format was used to allow for discussion of additional pertinent topics that may arise during an interview. Information gathered from interviews was then analyzed to develop common themes among municipal light plants to help understand the different factors that may influence wind energy plans.

Three categories of wind energy ownership are used to classify communities: 1) direct ownership; 2) partial ownership (e.g., wind energy cooperatives); and 3) no ownership of wind energy. At the time of this research in early 2011, several MLPs owned and operated wind energy facilities, including Princeton, and Hull (Ipswich was beginning construction on a wind turbine in spring 2011). Another group of MLPs participate in wind energy through a cooperative wind energy project (Berkshire Wind Cooperative) with each community owning a portion of the overall project. A third group of light plants did not currently own, or have future plans to own and operate a wind energy facility.

CHAPTER 6: CASE STUDY FINDINGS

Research findings from each community are presented in the case studies below. Each case study provides an overview of the factors involved in decisions on wind energy by municipal light plants. Also, each case study contains relevant statistics on energy and other characteristics for each community. The level of wind energy ownership for each case study is shown in Table 9.

Table 9: Wind Energy Ownership in Communities Studied

Direct Ownership[92]	Cooperative Ownership of Wind Energy	No Wind Energy Ownership as of January 2011
Hull	Holden	Danvers
Ipswich	Peabody	Georgetown
Princeton		Middleton

Ipswich Municipal Light Department

Ipswich Municipal Light Department (IMLD) provides electricity to approximately 6,912 customers within the Town of Ipswich. The average rate for electricity supplied by IMLD was 13.53 cents/kWh in 2010 as shown in Table 10. The population density for Ipswich is relatively low with 412 people per square mile. Its proximity to the coastal area gives the town access to sites with ideal wind speeds for wind turbines.

Table 10: Ipswich, MA Wind Energy Characteristics

Avg Annual Wind Speed (m/s)	Persons/ Sq miles	# Electric Utility Customers[a]	Sales of Electricity (MWh)[a]	Avg. Retail Price 2010 (cents/kWh)[a]	Wind Power	% Electricity Wind Power
6.5	412	6,912	110,834	13.53	1.6 MW	3%

[a] Utility customers, electricity sales, and price data from U.S. EIA[93]

[92] Operational dates for wind turbines are as follows: Hull (Turbine 1) December 2001; Hull (Turbine 2) May 2006; Ipswich June 2011; Princeton January 2010.

IMLD operates a wind energy project on a landfill in Ipswich as part of a partnership with the Ipswich School District. The wind energy project consists of a 1.6 MW turbine that is operated by the light department. Before the light department proceeded with the project, community support for the project was determined at a town meeting in 2008 where 600 residents voted to unanimously support the project.[94] The initial wind turbine manufacturer that was chosen by Ipswich, AAER, Inc. of Canada, went bankrupt in 2010.[95] Ipswich had to re-bid the contract, and ultimately selected General Electric to supply the wind turbine, which became operational June 2011.[96] In addition to the delay getting a supplier for the wind turbine, the town also was unable to find a buyer for its allocation of CREBs, forcing the town to rely on traditional financing for the turbine costs of 4.7 million.[97]

Wind speed data collected at the site showed that the typical wind speed is 13.1 miles-per-hour at the height of the turbine.[98] The project is estimated to produce 3 million kWh/year and "shave nearly 1,950 tons off its annual carbon emissions".[99] Additionally, information from ICARE (Ipswich Citizens Advocating Renewable Energy) states; "wind power creates energy without the byproduct of pollutants. It is a clean energy that

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[93] U.S. Energy Information Administration, "Electricity Reports," *Electric Sales, Revenue, and Average Price,* accessed July 12, 2012, http://www.eia.gov/electricity/sales_revenue_price.

[94] Ipswich Renewable Energy, "Greenhouse Gas (GHG) Inventory for Ipswich released," *Ipswich Citizens Advocating Renewable Energy (ICARE)*, accessed November 15, 2010, http://www.ipswichrenewableenergy.org/.

[95] Bethany Bray, "Piece by piece, wind turbine finally arrives," *Salem News*, March 31, 2011, http://www.salemnews.com/local/x300767432/Piece-by-piece-wind-turbine-finally-arrives.

[96] Ibid.

[97] Ibid.

[98] Ipswich Renewable Energy, "ICARE", *Wind Turbine*, accessed November 15, 2010, http://www.ipswichrenewableenergy.org/WindTurbineFAQ.pdf.

[99] Ibid.

doesn't contribute to global warming, acid rain or air pollution. Clean energy from the turbine proposed in Ipswich would offset electricity that must otherwise be made from fossil fuel sources."[100] The financial benefits to the town and community were are estimated at $2.5 million for the School Department and $500,000 for the light plant over the 20 years the turbine is estimated to be in operation.[101]

Tim Henry, the manager for the Light Department, stated that the "strong public desire, and concern about greenhouse gases" was a factor in why the community supported the wind energy project.[102] Henry also explained that Ipswich has "a citizen group that has been very strong. [The community] has been advocating for the utility to do something".[103] And that "there is a group called ICARE, so selling the project has been real easy."[104] ICARE, a citizen group supportive of wind energy, was a factor in creating a successful project according to Henry. The community group ICARE, founded in 2005 by the former superintendent of the Light Department, is a community group made up of citizens "who all believe that Ipswich can be an environmental leader for clean energy".[105]

Local ownership of the project was also a factor in the community's support for the wind energy project. Henry explained, "you have more say [with a municipal light plant] about where you get the power."[106] Support from ICARE and citizens supportive of "green energy" within Ipswich, kept the project moving forward in the face of

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[100] Ibid.
[101] Ibid.
[102] T. Henry, personal communication, January 11, 2010.
[103] Ibid.
[104] Ibid.
[105] Ipswich Renewable Energy, "ICARE", *Wind Turbine*, accessed November 15, 2010, http://www.ipswichrenewableenergy.org/WindTurbineFAQ.pdf.
[106] Ibid.

challenges getting a turbine supplied and inability to finance the project through CREBs. The turbine has not operated for a full year, but is expected to supply approximately 3% of the town's electricity.[107] Since monitoring of its energy output began in May 2011, the turbine has produced approximately 3,588,010 kWh of electricity through August 2012.[108] It also has reduced CO2 emissions by approximately 5,252,753 lbs.[109] Ipswich is continuing to pursue wind energy, and in the future, may construct a second 1.6MW turbine using a public private partnership.[110] This would allow the light plant to develop additional wind energy resources without taking on the burden of financing the project while still receiving energy from the project.

Princeton Municipal Light Department

Princeton Municipal Light Department (PMLD) currently owns and operates a wind power facility on a portion of Wachusett Mountain. PMLD provides electrical services to 1,526 customers as shown in Table 11.

Table 11: Princeton, MA Wind Energy Characteristics

Avg Annual Wind Speed (m/s)	Persons/ Sq.miles	# Electric Utility Customers [a]	Sales of Electricity (MWh) [a]	Avg. Retail Price 2010 (cents/kWh) [a]	Wind Power	% Electricity Wind Power
5.5	99	1,526	15,063	20.77	3.0 MW	40%

[107] Bethany Bray, "Piece by piece, wind turbine finally arrives," *Salem News*, March 31, 2011, http://www.salemnews.com/local/x300767432/Piece-by-piece-wind-turbine-finally-arrives.

[108] Power Dash, "System Profile," *Ipswich Wind 1,* accessed August 11, 2012, http://www.powerdash.com/systems/1000414/

[109] Ibid.

[110] T. Henry, personal communication, January 11, 2011.

[a] Utility customers, electricity sales, and price data from U.S. EIA[111]

PMLD owns and operates two 1.5 MW wind turbines that became operational in January 2010. The wind turbines supply approximately 40% of Princeton's electricity requirements.[112] The new wind turbines replace its first wind farm that was constructed in 1984 and produced about 2% of the town's energy annually, until it was dismantled in 2003-2004. PMLD does not have plans to develop additional wind energy capacity. The Department's manager, Jonathan Fitch, stated, "we're really getting used to them. We're going to watch them next year."[113] Further expansion of wind power could potentially trigger "costs to interconnect to other grids"[114] which can be expensive.

The current wind power facility was initially supported in a town-wide survey, with "78 percent of respondents favoring larger, more efficient units" to replace the older wind farm.[115] At a special town meeting in 2003, "74 percent majority of Princeton residents approved the wind farm project"[116] The high level of community support for the project may be explained by the town's previous experience with wind energy. Also, the site of the wind farm has higher average wind speeds than surrounding areas, which results in a high output from the turbine and ultimately more electricity that is produced.

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[111] U.S. Energy Information Administration, "Electricity Reports," *Electric Sales, Revenue, and Average Price,* accessed July 12, 2012, http://www.eia.gov/electricity/sales_revenue_price.

[112] Princeton Municipal Light Department, "Background and upgrade plan," *Wind Farm*, accessed March 11, 2011, http://www.pmld.com/Home.htm.

[113] J. Fitch, personal communication, January 13, 2011.

[114] Ibid.

[115] Phyllis Booth, "Something's in the wind in Princeton – New windmills will recall historic event", *Landmark*, July 16, 2009, http://www.wachusett.com/TheMountain/WachusettIsGreen/NewEraofWindPower/tabid/520/Default.aspx.

[116] Ibid.

The ability to control the project through the light plant was another factor that may have led to community support. On its website, Princeton municipal light department states the "most important aspect of being a municipal department is local control where local residents are responsible for the policies and direction of the department."[117] The light department also acknowledges the importance of its actions to the community it serves. The light department's website notes that "[g]enerating and purchasing renewable energy makes a difference in our community. In 2010, PMLD purchased approximately 11% of its energy from various hydroelectric power plants throughout the region. This renewable energy is purchased at very favorable costs compared to market and contact power costs".[118] Fitch stated that support for wind energy by the community was a large factor in the department's decision to pursue wind energy. "The community supported it, [and] we are owned by the community".[119] Fitch acknowledged that, from the light plant's perspective, "community support is key".[120] The light department acknowledges by generating and purchasing renewable energy, it is responding to the values of the community.

While community support was important to the project, it also needed to be financially acceptable from the light plant's perspective. Fitch stated "we can only do it if we can justify it financially. If the community is okay paying a premium, that's okay, but you have to justify it financially".[121] The wind project operated by PMLD has a positive financial return for the community. However, savings are used for infrastructure

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[117] Princeton Municipal Light Department, "History of the Princeton Municipal Light Department," *History*, accessed March 11, 2011, http://www.pmld.com/Home.htm.

[118] Princeton Municipal Light Department, "PMLD's Current Energy Portfolio and Strategy," *Energy Portfolio*, accessed March 11, 2011, http://www.pmld.com/Home.htm.

[119] Ibid.

[120] Ibid.

[121] Ibid.

replacement costs instead of reducing the price of electricity supplied by the utility. In the long term, the savings from the wind turbines will be invested in infrastructure to save on future costs paid by ratepayers.

The actual financial benefits from the wind energy project have been lower than initially anticipated according to Fitch. The lower return is largely attributed to the decrease in the price of RECs, which are purchased by the Mass Energy Consumer Alliance, a non-profit that seeks to make energy more affordable and environmentally sustainable for Massachusetts consumers.[122] The Mass Energy Consumer Alliance runs the New England Wind Fund, which allows residents in New England to "match" their energy use with green energy, which is supplied through the funds long term contracts to purchase RECs from wind energy projects throughout New England.

The wind energy project in Princeton was the result of strong community support and willingness by the light plant. Several factors, including a prime site for wind energy and previous experience with wind energy, may have also influenced the municipal light plant. However, the project made "financial sense", and therefore the light plant supported it. Princeton helps illustrate that support from both the community and the light plant is important for successful wind energy projects.

Hull Municipal Light Plant

Hull Municipal Light Plant (HMLP) has experience owning and operating wind energy projects that dates back to the early 1980s. The light plant currently owns and

[122] Mass Energy Consumers Alliance, "Support for Princeton, MA Wind Turbines," *Renewable Energy*, accessed November 15, 2010, http://www.massenergy.org/renewable-energy/negs/newsletters/apr-08-support-princeton-ma-wind-turbines.

operates a 660KW turbine, a 1.8 MW turbine, along with 765KW from Berkshire Wind Power for a total of approximately 3.2 MW of wind energy as shown in Table 2.

Table 12: Hull, MA Wind Energy Characteristics

Avg Annual Wind Speed (m/s)	Persons/Sq. miles	# Electric Utility Customers [a]	Sales of Electricity (MWh) [a]	Avg. Retail Price 2010 (cents/kWh) [a]	Wind Power [b]	% Electricity Wind Power
6.5	3,671	6,158	51,301	14.71	3.2 MW	10 %

[a] Utility customers, electricity sales, and price data from U.S. EIA[123]
[b] Includes 2.46 MW from owned wind turbines and 0.765 MW from Berkshire Wind Power Cooperative

In early 1980s, the light plant constructed and operated a 40 KW wind turbine at "Windmill Point" across from Hull's High School until 1995 when it was destroyed by strong winds.[124] In 1997-1998, a citizen group called "Citizens Advocating for Renewable Energy" or CARE, was formed.[125] This group was eager to see the Windmill Point site "re-powered" and petitioned the light plant to undertake the construction of a new more modern turbine.

A 660KW wind turbine, known as "Hull 1" was operational in December 2001 and within its first year of operation it generated 1,597, 367 kWh.[126] The turbine offset the town's street lighting bill and produced a savings of $150,000 in addition to the sale of the RECs.[127] The Renewable Energy Credits from the first turbine are purchased by the Mass Energy Consumer Alliance. Based on the success of Hull 1, the Light Plant in

[123] U.S. Energy Information Administration, "Electricity Reports," *Electric Sales, Revenue, and Average Price,* accessed July 12, 2012, http://www.eia.gov/electricity/sales_revenue_price.

[124] Citizens for Alternative Renewable Energy, "History of Hull's wind project," *Light Plant*, accessed March 11, 2011, http://www.town.hull.ma.us/Public_Documents/HullMA_Light/History.doc.

[125] Ibid.

[126] Ibid.

[127] Ibid.

2006 completed "Hull 2" a 1.8 MW turbine built at the town's landfill. The turbine was initially projected at a cost of $1.8 million; however, the additional costs to construct at the landfill with the rising costs of the turbine itself resulted in the project costing $3.6 million.[128] These costs have resulted in a lower financial return for the turbine.[129] For Hull II, the light plant has entered into a 10-year contract with Harvard University to purchase the RECs that are generated.[130] It is estimated that Hull II will generate $1.8 million in RECs over the 10-year contract with Harvard.[131] The turbines also generate more than 10% of Hull's electricity each year.[132]

Since 2007, Hull Light Plant has been exploring the feasibility of an offshore wind project. Initially, plans were discussed about developing several offshore turbines totaling 15 MW in nameplate capacity, enough to meet the entire community's energy needs. However, Hull's current plans for offshore wind energy have been scaled back with a more modest goal of a one-turbine research project that would be funded partly by a $1.6 million Department of Energy grant.[133]

Hull, a pioneer in wind energy in Massachusetts, has pursued wind energy as a result of local proponents and above average wind resources. Hull is positioned to again be a leader for the state with its interest in an offshore wind turbine.

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[128] R. Miller, personal communication, January 11, 2011.

[129] Ibid.

[130] Harvard College, "Harvard to purchase renewable energy credits," *Harvard University Gazette*, June 15, 2006, http://www.news.harvard.edu/gazette/2006/06.15/09-energy.html.

[131] Drake Lucas, "Monetary Benefits; Wind Power is Paying Off," *Patriot Ledger*, Quincy, MA, June 15, 2006, http://www.patriotledger.com.

[132] U.S. Department of Energy, "Hull, Massachusetts Wins DOE Wind Power Pioneer Award," *EERE News*, accessed June 29, 2012, http://apps1.eere.energy.gov/news/progress_alerts.cfm/pa_id=112.

[133] Ibid.

Holden Municipal Light Department

The town of Holden established its Municipal Light Department in 1911 with $600.[134] Its mission statement is "to provide reliable and cost effective energy services, in a responsible and courteous manner, which meets the current and future needs of customers."[135] In the annual town report, the light department also states that the "department will meet or exceed applicable environmental regulations, keeping customers informed of the progress and costs involved."[136] The light department currently serves over 7,000 customers as shown in Table 13, and has annual sales of over $14 million dollars.[137]

Table 13: Holden, Wind Energy Characteristics

Avg Annual Wind Speed (m/s)	Persons/Sq. miles	# Electric Utility Customers [a]	Sales of Electricity (MWh) [a]	Avg. Retail Price 2010 (cents/kWh) [a]	Wind Power (Berkshire wind ouput)	% Electricity Wind Power [b]
5.5	505	7,312	98,381	12.99	1.04 MW	7.70 %

[a] Utility customers, electricity sales, and price data from U.S. EIA[138]
[b] Estimate of wind power % based on Holden's 6.9 % share of Berkshire Wind Power Cooperative's production of 52,500 MWh/year. [139]

The light department is governed by the Holden board of selectmen who act as light commissioners. There is also a Municipal Electric Power Advisory Board, which

[134] Town of Holden, "2009 Holden Annual Town Report", p. 110, *About Holden*, accessed March 11, 2011, www.townofholden.net/Pages/HoldenMA_About/2009townreport.pdf.
[135] Ibid., 114.
[136] Ibid.
[137] Ibid., 110.
[138] U.S. Energy Information Administration, "Electricity Reports," *Electric Sales, Revenue, and Average Price,* accessed July 12, 2012, http://www.eia.gov/electricity/sales_revenue_price.
[139] Berkshire Wind Power Cooperative Corporation, "Berkshire Wind Power Fact Sheet," *Quick Facts,* accessed July 12, 2012, http://www.berkshirewindcoop.org/documents/DedicationFactSheetsPublisher.pdf

controls the daily operations of the Holden Municipal Light Department. Members of the advisory board are appointed by the Town Manager.

Holden is one of five municipal light plants that has joined the Massachusetts Renewable Energy Trust Fund (MassRET) administered by the MassCEC a quasi-public agency that "serves as a clearing house and support center for the clean energy sector" according to its website.[140] The Light Department feels that participation in the MassRET would allow citizens in the community to access the grants available to the customers served by IOUs from MassCEC's Renewable Energy Trust Fund. In its advisory board minutes it states "membership would allow the town residents and businesses, including the town itself, to apply for grants to install alternative energy projects such as solar panels or wind turbines".[141]

The light department has a partial ownership stake in the Berkshire Wind co-operative that is also owned by 13 other light plants, on Brodie Mountain in Hancock, MA. The project consists of ten 1.5 MW turbines for a total of 15 MW generating capacity.[142] Holden MLP receives approximately 6.9% share of the output, or 1,041 kW from the Berkshire Wind Power project.[143] Based on the 6.9 % share of the Berkshire Wind Power's generation (52,000 MWh/year), approximately 7.7% of Holden's electricity is provided by wind energy.

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[140] Massachusetts Clean Energy Center, "Our Mandate," *About MassCEC*, accessed July 9, 2012, http://www.masscec.com/index.cfm/page/Our-Mandate/pid/10234.

[141] Holden Municipal Electric Power Advisory Board, "Municipal Electric Power Advisory Board," *Minutes*, December 4, 2008, http://www.townofholden.net/pages/HoldenMA_HMLDMin/2008meetingminutes/dec0408.

[142] Berkshire Wind Power Cooperative, "Project Facts," *Using Wind*, accessed March 11, 2011, http://www.berkshirewindcoop.org/Project_Facts.html.

[143] Berkshire Wind Power Cooperative, "Berkshire Wind Power Facts", *Project Facts, accessed June 29, 2012,* http://www.berkshirewindcoop.org/documents/DedicationFactSheetsPublisher.pdf.

While the light department is not planning any of its own wind power projects, beyond its involvement in the Berkshire Wind Cooperative, the Wachusett Regional High School located in Holden is considering a utility-scale turbine. The light plant manager, James Robinson, stated that the light plant is neither for nor against the project. However, he noted that the high school might want to sell surplus electricity back to the utility that is in excess of what can be used on site. Robinson stated that this scenario could be undesirable since the cost of energy from the school's turbine, if purchased by the light plant, could lead to higher costs for the rest of ratepayers in Holden.

Holden municipal light plant demonstrates that a light plant can be supportive of wind energy and other renewable energy sources in the community it serves. While the municipal light plant is not pursing its own wind energy, it is participating in the Berkshire Wind Energy Cooperative. Furthermore, it has joined the MassRET that creates an incentive for private and public wind energy projects in the community.

Peabody Municipal Light Plant

Peabody Municipal Light Plant (PMLP) is the largest municipal electric utility among the case studies, with 25,250 customers and electrical sales of 502,933 MWh/year.[144] Currently the light plant participates in the Berkshire Wind Cooperative, where it has the largest share of the output (18% or 2.7 MW).[145] Based on PMLP's electrical sales of 502,933 MWh/year, its portion of the output from Berkshire Wind

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[144] U.S. Energy Information Administration, "Electricity Reports," *Electric Sales, Revenue, and Average Price,* accessed July 12, 2012, http://www.eia.gov/electricity/sales_revenue_price.

[145] Berkshire Wind Power Cooperative, "Berkshire Wind Power Facts," accessed July, 11 2012, http://www.berkshirewindcoop.org/documents/DedicationFactSheetsPublisher.pdf

equals approximately 1.9 % of its electricity supply. Table 14 provides additional wind energy characteristics for Peabody.

Table 14: Peabody, MA Wind Energy Characteristics

Avg Annual Wind Speed (m/s)	Persons/Sq. miles	# Electric Utility Customers [a]	Sales of Electricity (MWh) [a]	Avg. Retail Price 2010 (cents/kWh) [a]	Wind Power (Berkshire wind output)	% Electricity Wind Power [b]
5.5	3,154	25,250	502,933	12.67	2.7 MW	1.9 %

[a] Utility customers, electricity sales, and price data from U.S. EIA[146]
[b] Estimate of wind power % based on Peabody's 18.18% share of Berkshire Wind Power Cooperative's production of 52,500 MWh/year. [147]

The amount of the investment in Berkshire Wind among the participants was allocated based on the size of the utility. The light plant is also "investigating [and] considering" a possible wind energy project within Peabody, but it will need to collect wind speed data for sites.

However, despite ambitions to be "green", the current low cost of wholesale energy and the economic recession were cited as near term factors that could prove challenging for any possible project.[148] "The community is interesting, everywhere you go the community is all about it until you try to get it built. There are people who don't want it in their backyards. In Peabody, the people want it but they are cautious."[149]

Peabody's environmental policy states, "The Peabody Municipal Light Plant is committed to the protection of our environment and to the welfare and safeguard of our

[146] U.S. Energy Information Administration, "Electricity Reports," *Electric Sales, Revenue, and Average Price,* accessed July 12, 2012, http://www.eia.gov/electricity/sales_revenue_price.

[147] Berkshire Wind Power Cooperative Corporation, "Berkshire Wind Power Fact Sheet," *Quick Facts,* accessed July 12, 2012, http://www.berkshirewindcoop.org/documents/DedicationFactSheetsPublisher.pdf

[148] Ibid.

[149] W. Waters, personal communication, December 1, 2010.

community. We will provide our customers with economical, safe, and reliable energy in an environmentally responsible manner…we will strive to reduce the amount of waste we generate. We will commit to and implement a process of continual development".[150]

Peabody's light plant is considering wind energy, but there appears to be inconsistent support among residents in Peabody. The lack of support by the community has led the light plant to pursue wind energy more cautiously.

Georgetown Municipal Light Department

Georgetown Municipal Light Department is not currently planning a wind energy project, or ownership though co-operative, such as Berkshire Wind. As shown in Table 15, the light department obtains approximately 3% of its power supply from wind by purchasing from an out of state wind energy project.

Table 15: Georgetown, MA Wind Energy Characteristics

Avg Annual Wind Speed (m/s)	Persons/Sq. miles	# Electric Utility Customers [a]	Sales of Electricity (MWh) [a]	Avg. Retail Price 2010 (cents/kWh) [a]	Wind Power (Spruce Mtn output) [b]	% Electricity Wind Power [b]
5.5	674	3,464	48,473	14.99	0.52 MW	3 %

[a] Utility customers, electricity sales, and price data from U.S. EIA[151]
[b] Estimate of wind power amount and % provided by Georgetown Municipal Light Department

One reason for not pursing wind within the town is the concern about the possible impact on residential areas. The light manager, Wayne Snow, stated that Georgetown is

[150] Peabody Municipal Light Plant, "Environmental Policy," *Environmental Policy*, accessed March 11, 2011, http://www.pmlp.com/environ.html.

[151] U.S. Energy Information Administration, "Electricity Reports," *Electric Sales, Revenue, and Average Price,* accessed July 12, 2012, http://www.eia.gov/electricity/sales_revenue_price.

"populated with high priced homes…not everyone wants a 300-400 foot tower in their back yard.[152] Snow also commented that, Georgetown is "pretty rural…but there are a lot of homes". The perceived conflict with wind turbine and residential areas is a reason that Georgetown has not pursued ownership of wind energy. In weighing its decision, the perceived lack of community support for wind energy was also a factor. "Is there a real push [for wind energy] in town? No, [because the town is a] bedroom community."[153]

Additionally, Snow stated the "financial [cost] is a second concern, it can be argued that the money [to fund a wind project] could be mixed into the supply without an impact."[154] Despite the ability to make the costs of a wind energy project minimal to the ratepayers, Snow cited limitations to the wind energy turbine technology. Mainly, that "[w]ind turbines don't have great capacity, the wind has to be blowing…its around 28%….the times its not spinning its not doing anything. It's going to take a long time to repay a 28% capacity factor."[155]

The Light Department negotiated a PPA with Patriot Renewables, LLC Spruce Mountain Wind project in Woodstock Maine for around "10.9 cents a kWh". [156] The contract to purchase energy from this wind energy project gives Georgetown exposure to wind energy without the larger commitment of constructing its own turbines or creating conflict with residential areas. The Light Department receives 2.6% of the output from the Spruce Mountain Wind project (about 520 kW), which is approximately 3% of Georgetown's electricity supply. [157]

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[152] W. Snow, personal communication, November 23, 2010.
[153] Ibid.
[154] Ibid.
[155] Ibid.
[156] Ibid.
[157] W. Snow, personal communication, July 31, 2012.

Middleton Municipal Light Plant

Middleton Municipal Light Plant is not planning a wind energy project and the light plant does not have an investment in the Berkshire Wind Cooperative.[158] As shown in Table 16, the light plan serves approximately 3,489 customers, and had sales of electricity of 101,573.

Table 16: Middleton, MA Wind Energy Characteristics

Avg Annual Wind Speed (m/s)	Persons/Sq. miles	# Electric Utility Customers [a]	Sales of Electricity (MWh) [a]	Avg. Retail Price 2010 (cents/kWh) [a]	Wind Power Project	% Electricity Wind Power
5.5	661	3,489	101,573	14.03	n/a	n/a

[a] Utility customers, electricity sales, and price data from U.S. EIA[159]

The light plant is looking into PPA for several wind energy projects, including the Spruce Mountain a wind farm being developed by a private developer in Maine. One of the reasons for pursuing a PPA was that "the sites are somewhat limited" in Middleton. The light plant manager, Mark T. Kelly, stated that there is a site owned by MIT with good wind speeds. He suggested that, if MIT finds that it is a feasible site for wind energy, there could be "a possibility for a cooperative" with the light plant[160].

The light plant manager perceives community support for wind energy as low among the general population. Kelly stated, "In Middleton there hasn't been a large outcry [for renewable energy because of the low] carbon footprint of our energy mix

[158] The Berkshire Wind Cooperative is owned by several municipal light plants and MMWEC (Massachusetts Municipal Wholesale Electric Company) a non-profit entity created by Massachusetts Law that provides energy purchasing services to municipal light plants and financing for projects. Participation in the Berkshire Wind Cooperative was limited to the full-members of MMWEC.

[159] U.S. Energy Information Administration, "Electricity Reports," *Electric Sales, Revenue, and Average Price,* accessed July 12, 2012, http://www.eia.gov/electricity/sales_revenue_price.

[160] M. Kelly, personal communication, January 27, 2011.

[since it includes nuclear]."[161] According to Kelly, most people in Middleton "are satisfied by the energy sources that the light plant uses."[162] The mix of energy sources, from hydroelectric to nuclear, gives the utility a lower carbon footprint than other utilities. However, the light plant manager stated "if a deal comes along and its reasonable, then we throw it into the mix…the commissioners don't mind paying a little more…but it crosses a line if it's too much."[163] Middleton's willingness to invest in wind energy comes from its desire to purchase energy that is competitive with prices for conventional energy.

Danvers Municipal Light Department

Danvers Municipal Light Department provides electrical service 13,039 customers and has electricity sales of approximately 326,841 MWh a year as shown in Table 17.

Table 17: Danvers, MA Wind Energy Characteristics

Avg Annual Wind Speed (m/s)	Persons/Sq. miles	# Electric Utility Customers [a]	Sales of Electricity (MWh) [a]	Avg. Retail Price 2010 (cents/kWh) [a]	Wind Power Project	% Electricity Wind Power
5.5	2,051	13,039	326,841	14.21	n/a	n/a

[a] Utility customers, electricity sales, and price data from U.S. EIA[164]

The light department is not currently planning any utility-scale wind energy projects. According to Coleen O'Brien-Pitts, the Department's utility director, there was

[161] Ibid.
[162] Ibid.
[163] Ibid.
[164] U.S. Energy Information Administration, "Electricity Reports," *Electric Sales, Revenue, and Average Price,* accessed July 12, 2012, http://www.eia.gov/electricity/sales_revenue_price.

discussion about a wind turbine at Folly Hill, but the abutters didn't want it."[165] The lack of potential sites was a reason given for not pursing any wind energy plans. The sites available in Danvers do not have the characteristics suitable for utility scale wind."[In Hull] it's not an eyesore, its not blocking anyone's view, it's an ideal situation…that's a win-win."[166]

Similarly, when talking about Berkshire Wind Cooperative, O'Brien-Pitts stated "it's not here in my backyard, its close enough, its not aggravating people, and its low risk…your going into it with other communities, they will buy the power." [167] Since Danvers MLP is not part of MMWEC, they do not participate in the Berkshire Wind Power project, which was only offered to full members of MMWEC.

While the light plant is not planning any utility-scale wind energy projects, they have considered testing various models of residential sized turbines that could be part of a future department supported program for residents. Danvers is going to "pick two of the smaller turbines to look into the feasibility (for residential homeowners) with some type of rebate.[168] Danvers also cited the need to satisfy different customer groups as a possible barrier to wind energy. O'Brien-Pitts stated "[Danvers has] a variety of stake holders: businesses want [electricity] to be cheap, reliable…some people want it to be green. We have to balance [those interests]".[169]

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[165] C. O'Brien-Pitts, personal communication, November 18, 2010.
[166] Ibid.
[167] Ibid.
[168] Ibid.
[169] C. Underhill, personal communication, November 18, 2010.

CHAPTER 7: CASE STUDIES SUMMARY AND THEMES

The data collected from communities shows that several factors may influence the decisions on wind energy by municipal light plants. Table 18 presents a summary of the main questions asked during interviews.

Table 18: Summary of Interview Questions and Responses

Question #1	MLP	Project? (PPA)	Planning?
Planning wind projects	Danvers	No	No
	Georgetown	No (Yes)	No
	Holden	Yes	No
	Hull	Yes	Yes
	Ipswich	Yes	Yes
	Middleton	No (Yes)	No
	Peabody	No	Yes
	Princeton	Yes	No
Question #2	**MLP**	**Primary Factor(s)**	**Secondary Factor(s)**
Factors influencing ownership of wind energy	Danvers	Lack of community support	Skeptical of wind energy technology and high cost
	Georgetown	Negative impact on residential areas	Perceived high cost
	Holden	Diverse energy supply	Supports green energy
	Hull	Community advocacy, good location	Financial benefits
	Ipswich	Strong public desire and concern about greenhouse gases	Community advocacy
	Middleton	Limited number of sites	Weak community support
	Peabody	Concern of global warming	Cost benefits
	Princeton	Community support	Good location for wind energy
Question #3	**MLP**	**Strong**	**Weak**
Community support for wind energy	Danvers		✓
	Georgetown		✓
	Holden	✓	
	Hull	✓	
	Ipswich	✓	
	Middleton		✓
	Peabody		✓
	Princeton	✓	

Question #4	MLP	Yes	No
Utility targets for renewable energy (wind energy)	Danvers		✓
	Georgetown		✓
	Holden		✓
	Hull		✓
	Ipswich		✓
	Middleton		✓
	Peabody		✓
	Princeton		✓

The Role of Community

For light plants that currently own and operate wind energy generation facilities, or are planning to develop wind energy, community support appears to be an important factor.

In Princeton, the municipal light department's manager stated that "[c]ommunity support is key" when talking about the reasons why the light plant built its own wind farm in 2009.[170] He also noted the level of community support for the wind farm program was tested through votes at public meetings. When the light plant was deciding whether to pursue wind energy, the department "asked the town what they wanted to do…and the town voted".[171] Unlike wind energy projects developed by private companies, local ownership of the electric utility gives a community a way to participate in the decisions regarding the source of future energy supplies. In Princeton, the role of the light plant was to present information including financing and ownership plans for the wind energy project and allow the community to make a decision.

[170] J. Fitch, personal interview, January 13, 2011.
[171] Ibid.

Similarly, in Hull where the light plant operates two utility-scale turbines, community support was important. Initially, proponents supportive of wind energy brought a proposal to the board of selectmen to construct a modern utility scale wind turbine at the site of an older, outdated, turbine operated by the light plant near the school. The success of Hull's first utility scale wind turbine project, including its financial benefits, led the community to support a larger wind turbine that was constructed at the landfill. When comparing the two projects (Hull 1 and Hull 2), the light plant manager, Dick Miller, noted that Hull 2 was more costly to construct, and has a slightly lower capacity factor, resulting in a lower financial return for the project.[172] However, community support for the second wind turbine made the project possible.

In Ipswich the light plant manager, Tim Henry, stated the "board of selectmen are also the electric commissioners, as long as they have goals to reduce greenhouse gases we will keep pursing renewable energy projects".[173] He noted that Ipswich is a "community that is very green" and supports the light plant's plans to build a wind turbine.[174] The "green" benefits of wind energy were an important aspect to the project in addition to the financial benefits.

In communities without wind energy plans, such as Middleton, wind energy is viewed in terms of its cost competitiveness with conventional sources of fuels. Additionally, in Danvers and Georgetown, community support was not a factor and neither light plant had plans for wind energy. In Georgetown, the light plant manager, stated, "you have to follow the community thinking, we are all in the same boat".[175]

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[172] R. Miller, personal communication, January 11, 2011.
[173] T. Henry, personal communication, January 11, 2011.
[174] Ibid.
[175] W. Snow, personal communication, November 23, 2010.

Municipal light plants are owned by the community they serve, and therefore are responsive to the community's interests and expectations whether it is supportive of wind energy or not.

The Influence of State and Federal Wind Energy Policy

State and federal incentives available for wind energy projects do not appear to have a strong influence on municipal light utilities. In communities with wind energy projects, the actual financial incentives received from federal and state programs were less than anticipated. Also, several state programs for renewable energy exempt municipal light plants. In Danvers, the light plant official stated "if they are not a light plant, [you] can get grants programs that pay the capital costs… If you're a light plant it doesn't work that well functionally".[176] In Middleton, the light plant manager stated, "[m]unicipals have been set aside" by state energy program and policies.[177] Also, that light plants are "still fighting for some grants through the RGGI. Right now they've [the Green Community Program] given out $80 million. If you look at the municipals, they are about 13% of the load, so about $8 million should have gone to the municipals".[178]

The concern regarding control over funds in state programs for renewable energy was also noted in Ipswich, where the light plant has "made a conscious decision not to join the [Renewable Energy Trust Fund]." Once the community "opts in we can't get out". The Green Communities Act makes a MLP's decision to join the renewable energy trust fund irrevocable.[179] MLPs are required to sign a participant agreement when

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[176] C. O'Brien-Pitts, personal communication, November 18, 2010.
[177] M. Kelly, personal communication, January 27, 2011.
[178] Ibid.
[179] Massachusetts Clean Energy Center, "Renewable Energy Generation", *Municipal Light Plant Participation in the Renewable Energy Trust,* accessed November 2, 2012,

they join the fund, and are required to repay any funds if they break the contract.[180] Unlike communities serviced by IOUs, communities with municipal light plants can institute a charge on electricity bills that can be used to fund renewable energy projects in that community, as well as projects by the light plant. This would allow the light plant to control the funds that are contributed by its ratepayers, as well as insure that funds are kept within their community.

In Ipswich, the light plant manager noted that the "state is not allowing us to get this program" which is funded through the RGGI surcharge applied to all power plants based on GHG emissions. This surcharge ultimately increases the cost for all purchasers of electricity, including municipal light plants. While the town does not receive funding from the Green Communities program, "the power plants are putting [the extra charge] into the rates" that are also paid by municipal light plants.[181]

The Renewable Portfolio Standard was another program that appears to have little influence on municipal light plants since municipal light plants are exempted from meeting the requirements of this policy. However, municipal light plants are able to sell Renewable Energy Credits (RECs) that are generated by renewable energy facilities they own. Yet, the financial benefit from the sale of RECs has been lower than expected from the communities that own wind energy projects. In Princeton, the light plant manager noted, "The REC market is being diluted by other projects such as biomass which along with landfill gas is 40% of the RPS credits".[182] "We're getting the market price for

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http://www.masscec.com/index.cfm/page/Municipal-Light-Plant-Participation-in-the-Renewable-Energy-Trust/cdid/11251/pid/11160

[180] Ibid.

[181] T. Henry, personal communication, January 11, 2011.

[182] J. Fitch, personal communication, January 13, 2011.

RECs, we have these policies that are not conducive to generating more wind energy".[183] "When I first built the project, the RECs were going for $40 per REC" and "Right now, we're getting between $12 and $15 to sell a REC"[184] Fitch further noted, "60% of the RPS market made up of something that burns something"[185] The lower price for the RECs generated by Princeton's wind energy project ultimately reduces the financial benefit that the community receives from its wind energy project.

Influence of Energy Prices

Since the energy supply in Massachusetts has a large component from fossil fuels (natural gas), the financial incentive for renewable energy, including wind energy, fluctuates with the cost natural gas. When the price of fossil fuels is low relative to renewable fuel sources, the financial incentive provided by renewable energy is reduced and communities may opt to stay with fossil fuels rather than switch to renewable sources. When fossil fuel prices rise, it creates a financial incentive to develop renewable sources of energy, because a light plant will save a greater amount by reducing its purchases of electricity. At the time research was conducted in early 2011, a low price for natural gas has resulted in the lowest costs for electricity in three years (2008-2011). The manager in Ipswich stated, "it's hard to make the numbers work because the price of natural gas has dropped"[186] Similarly, in Holden, the manager stated that, since "natural gas is low, there is an excess of generating capacity, [and that] wholesale prices are around 4 cents/kWh".[187] He also noted that "only two years ago the spot price was 12

[183] Ibid.
[184] Ibid.
[185] Ibid.
[186] T. Henry, personal communication, January 11, 2011.
[187] J. Robinson, personal communication, November 15, 2010.

cents/kWh, but we wouldn't get that today".[188] The manager of the Princeton Municipal Light Plant also stated that prices affect how the community views a project. In Princeton, the light plant " did not sell [the wind energy facility] as a project that would reduce rates, when we sold the project, in the long term it will act as a rate stabilizer." The light plant is "upside down with energy prices".[189] While the project is predicted to save on costs in the long term, the low prices of fossil fuels have negated the financial benefits in the short term. The decision whether or not to build a wind energy project takes place within the context of several factors, one of which is the savings associated with the energy costs that are avoided by the renewable energy that is created. Despite the possibility of higher future costs of fossil fuels, the current low price reduces the incentive for municipal light plants to seek out alternative sources, including wind energy.

[188] Ibid.
[189] J. Fitch, personal communication, January 13, 2011.

CHAPTER 8: CONCLUSION

This thesis researched the question of what factors influence municipal light plants to develop wind energy supplies, including the effectiveness of current state and federal energy policy for wind energy as it relates to municipal light plants. This research shows that community support is an important factor in a municipal light plant's decision regarding wind energy projects. However, several other factors may also influence a light plant's willingness to develop its own wind energy sources including incentives created by wind energy policy, and the current market prices for conventional fuel sources. The following factors were identified as influencing a municipal light plant regarding wind energy ownership:

1) Light plants with an interest in developing their own wind energy projects viewed community support as a large part of the reason;
2) Light plants that did not build wind energy within their communities or participate in wind energy cooperatives, viewed wind energy in terms of financial competitiveness with fossil fuels;
3) State and federal polices for wind energy offer weak incentives to municipal light plants to build and own wind energy projects; and
4) Energy market prices, including the low costs for natural gas, appear to influence a light plant's decision whether to pursue wind energy.

This thesis helps demonstrate that municipal light plants have successfully developed wind energy projects responding to community interest and support. In the cases where MLPs built wind energy facilities within their own community, high levels of community support and participation existed, as demonstrated in Hull and Princeton.

In the examples from Hull and Princeton, the motivation for wind energy was from both the environmental and financial benefits it offered. In other communities (Middleton, Peabody, Danvers, Georgetown), this research found that uncertain financial incentives and perceived lack of community support led to less interest in wind energy projects by light plants.

This research also found that current state and federal policies provide weak incentives to municipal light plants. State policies for wind energy, which includes the Green Community Act (GCA), the Regional Greenhouse Gas Initiative (RGGI), the Clean Energy Center's Community Wind Grant Program, and the Massachusetts Renewable Portfolio Standard, do not offer compelling financial incentives for municipal light plants to pursue wind energy. Other programs such as Massachusetts Green Community Act exempt municipal light plants, and market-based incentives such as RPS and RECs provide uncertain benefits. Additionally, MLPs face a disadvantage since they do not get access to RGGI funds, while IOUs do.

On the federal level, the REPI program creates uncertainty for planning wind energy because it is subject to year-to-year appropriations from Congress. This has resulted in reluctance to "own" and assume the risk that benefits will be lower than predicted. Further, the complexity and uncertainty regarding CREBs has reduced the effectiveness of this program for creating wind energy projects among municipal utilities.

Greater inclusion and incentives for municipal light plants in state and federal energy policy is important to accelerate new wind energy supplies in Massachusetts. The structure of municipal light plants allows for greater public involvement in energy decisions, and may help promote acceptance of wind energy. However, state and federal

policies need to create compelling financial incentives that appeal for municipal light plants which are not motivated by tax incentives.

Also, while energy policies may set renewable energy goals for wind energy, they appear to fail to consider how benefits are provided to the community. MLPs in Massachusetts provide 13% of the electricity, yet they control 39% of the wind energy generation. Despite the fact that MLPs have been largely left out of the state's renewable energy policies, they control large percentage of wind energy. This shows that municipal light plants are able to effectively introduce wind energy generation into the communities they serve. Further, by improving wind energy policies for municipal light plants, it may possible to increase development of wind energy resources statewide.

Ownership of wind energy by municipal light plants distributes both the costs and the benefits of wind energy across communities. However, current wind energy incentives focus on increasing wind energy among private owners in the electrical sector. While this approach may help reach goals for the amount of wind energy, it overlooks the benefits to the community from more stable and lower energy costs. Also, public ownership of wind energy may help to increase support for wind energy, and therefore make wind energy easier to implement.

The results of this research show that greater financial incentives for municipal ownership of wind energy are needed. Major federal wind energy policies rely on tax credits that are not suitable for municipal light plants because they lack a tax liability. Since tax credits are "paid for" by forgoing tax revenue to the federal government, wind energy incentive programs should also be created for public, and non-profit entities that match the level and scope of tax credit programs. One way to create incentives for

municipal light plants would be to allow tax credits to be transferable to other parties not participating in the wind energy project, which would allow public entities to sell tax credits. The REPI program is an example of a program that provides incentives to publically owned wind energy projects. However, the level of funding for this program should be comparable to those that are offered to investor owned projects.

Further, the Berkshire Wind Power Cooperative Corporation demonstrates that wind energy projects can be successfully developed and owned by municipal utilities – particularly in a cooperative structure. A cooperative formation allows municipal utilities to build larger projects and achieve economies of scale. Despite weak state and federal incentives, the environmental benefits, and the long-term cost savings from wind energy are compelling reasons for municipal utilities to pursue wind energy. State incentives programs could recognize the benefits of this type of project and provide incentives specifically to them. This could help to develop wind energy projects in different regions of the state in a way that allows the public to participate in both the environmental and financial benefits of wind energy. Furthermore, this type of incentive program could create additional incentives for projects that are located in economically challenged locations.

It is evident that climate change offers compelling reasons to transition our energy supplies towards renewable sources of energy including wind energy. This research shows that municipal light plants have developed wind energy at a greater rate than privately owned projects. Municipal light plants are not only an important component of the Massachusetts electricity sector, but an important way to reach renewable energy goals.

Appendix A: Interview Questions

Is the utility currently planning any wind energy projects? Or if wind energy projects already exist, are there plans for additional wind energy capacity?

What factors have most strongly influenced your decision to pursue (or not pursue) ownership of wind energy?

- The estimated financial benefits (lower rates, greater stability)?
- The availability or lack of wind resources/sites?
- Environmental or health concerns (climate change, reduction of air pollution) by the community?
- Community support (local champions of wind energy)?
- Availability of financing/ and favorable costs of development/ownership?
- Perceptions of cost savings vs. expected expense?
- Federal/state incentives, REPI (Renewable Energy Production Incentive), RECs (State Renewable Energy Portfolio Standards)
- Ease of permitting or constraints?
- Energy security?

Has the community participated in plans to develop wind energy?

In what ways (survey, meetings)?

Community or advisory groups?

To what extent are sustainability issues incorporated into wind energy projects (poverty reduction, community involvement, employment)?

How are the benefits from wind energy distributed (or proposed to be distributed) to the community?

Offsetting of municipal energy costs?

Reducing rate for ratepayers?

Investment in infrastructure?

Has the utility set any targets for the amount of wind energy?

Did the utility take an ownership stake in Berkshire Wind power project and what influenced that decision?

Does the utility/municipality participate/intent to participate in the State's Green Community program?

Has the utility considered joining the Renewable Energy Trust?

How does wind energy fit into the utility's plans for meeting energy needs?

What if any barriers exist to developing wind energy?

Appendix B: Installed Wind Energy Capacity in Massachusetts as of 2011[190]

ADVOCATE	CITY/TOWN	CAPACITY (kWh)	TURBINES	INSTALLED
Town of Ipswich	Ipswich	1600	1	2011
Berkshire Wind Power Cooperative	Hancock	15000	10	2011
Mount Wachusett Community College	Gardner	3300	2	2011
Berkshire East Ski Resort	Charlemont	900	1	2011
Barnstable Wastewater Treatment Plant	Barnstable	200	2	2010
Nantucket High School	Nantucket	100	1	2010
Narragansett Regional Middle-High School	Templeton	1650	1	2010
Notus Clean Energy, LLC	Falmouth	1650	1	2010
Mount Saint Mary's	Wrentham	100	1	2009
Falmouth Wastewater	Falmouth	1650	1	2009
Princeton MLP	Princeton	3000	2	2009
Air Force Center for Engineering and the Environment (AFCEE)	Bourne	1500	1	2009
MWRA - Deer Island	Boston	1200	2	2009
Woods Hole Research Center	Woods Hole	100	1	2009
Bartlett's Ocean View Farm	Nantucket	250	1	2009
Mark Richey Woodworking	Newburyport	600	1	2009
City of Medford	Medford	100	1	2009
Nature's Classroom	Charlton	100	1	2009
Williams Stone	Otis	600	1	2009
Forbes Park	Chelsea	600	1	2008
Holy Name Central Catholic School	Worcester	600	1	2008
Hyannis Country Garden	Hyannis	100	1	2008
Jiminy Peak Mountain Resort	Hancock	1500	1	2007
Massachusetts Maritime Academy	Bourne	660	1	2006
Town of Hull 2	Hull	1800	1	2006
IBEW 103	Boston	100	1	2005
Town of Hull 1	Hull	660	1	2001
TOTALS		39620	40	

[190] Massachusetts Executive Office of Energy and Environmental Affairs, "Wind Energy Projects," *Wind*, accessed June 11, 2011, http://www.mass.gov/eea/energy-utilities-clean-tech/renewable-energy/wind/wind-energy-projects.html.

Appendix C: Characteristics of Communities with MLPs

Municipal Utilities (n = 18)	Avg Annual Wind Speed (m/s)	Wind Power Project or Planned	Climate Change	Environ mental Justice	Persons/Sq. miles (Less dense indicated by shading)	2008 Rates (13.34 average) per kWh	Per Capita Income (1999) < $25,900
Town of Ipswich	6.5	√	√		412	14.9	32,516
Town of Hull	6.5	√	√		3671	12.42	26,331
Town of Rowley	6.5				311	12.88	27,413
Town of Marblehead	6.5				4407	14.66	46,738
Town of Paxton	6				328	14.12	29,573
City of Hingham	6		√		1036	14.02	41,703
Town of West Boylston	5.5			√	629	14.02	22,899
Town of Holden	5.5		√		505	15.08	27,971
Town of Georgetown	5.5				674	15.25	28,846
Town of Princeton	5.5	√			99	17.23	32,232
Town of Chester	5.5	√			36	12.55	18,098
Town of Ashburnham	5.5	√			157	13.22	21,659
Town of Templeton	5.5	√			249	12.51	21,994
City of Peabody	5.5			√	3154	11.24	24,827
Town of Braintree Electric Light Dept.	5.5				2539	15.16	28,683
Town of Middleton	5.5				661	10.68	29,031
Town of Shrewsbury	5.5			√	1639	10.33	31,570
Town of Danvers	5.5				2051	11.14	26,852

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