

# TOWN OF PLYMOUTH

## Energy 2020 Framework



Prepared by  
RIDLEY & ASSOCIATES, INC.  
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## PURPOSE

The purpose of the Energy 2020 Framework Report is twofold: to help the Town qualify for participation in the Green Communities Program, and to set a path and timeline for reaching the Town's short-term and long-term energy goals. The Framework is intended to provide structure and at the same time allow flexibility to respond to evolution of rules, regulations and markets.

The Framework outlines development of the Town's energy program in three phases:

1) Initial Planning and Implementation Phase (2008-2010)

This is intended to provide analysis of the Town's energy profile and develop strategies and a process to refine goals, implement the first projects, and monitor progress. This includes establishing an Energy Officer to work in concert with the Energy Committee, town departments and the selectmen. It also includes establishing a "bench-marking" program of energy usage by facility, undertaking initial energy audits and upgrades at key municipal facilities, preparation and release of RFPs for wind energy development and solar projects, and examination of participation in power supply purchases.

This period also includes conducting analysis, and preparing and implementing a vehicle fuel efficiency program, and forming an interdepartmental "Green Team" to implement a program to augment energy efficiency activities. Based on monitoring and review of initial progress and experience during this period, a 5-year plan for Phase I would be developed.

2) Phase I (2011-2015)

Development of initial wind energy projects, and initial solar projects, based on the responses to the RFPs. Review and develop platform for power supply purchases. Undertake a second layer of energy audits and implement energy efficient operations and practices. Undertake determination on best practices for street lighting. Participate in Green Communities Programs. Review possible expansion of vehicle fuel efficiency and Green Team activities. Conduct annual monitoring, and refine and set a process for goals under a second 5-year plan for Phase II.

3) Phase II (2016-2020)

Based on Phase I determinations and second 5-year plan, support development of additional wind and solar projects deemed to be in the best interests of the Town and its residents and businesses. Undertake additional energy efficiency projects. Conduct annual monitoring and determine long-term course. Each of the topical sections of this report note the goals, accomplishments, and work to be conducted under the timeline of the Framework's three stages.

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## 1.0 BACKGROUND: Town of Plymouth Goals

### 1.1 Energy 2020 Goals

In 2007, the Plymouth Town Meeting set out the Energy 2020 goals to utilize a combination of supply and demand measures to provide 100 percent of municipal electricity from renewable sources; to achieve a corresponding reduction in emissions in line with the U.S. Mayors Climate Protection Agreement (reduction of 1990 levels by 7 percent by 2012); to achieve savings of millions of dollars in energy costs; and to stimulate growth of energy-related businesses, commerce, education and expertise—“making Plymouth a Green Energy hotspot.”

Although the focus of the 2020 Energy Program is on energy for municipal facilities, it is also seen as a strategy to encourage private projects to participate in the long-term effort. This includes putting policies and by-laws in place to encourage individual energy efficiency measures, development of wind generation and other renewable energy projects, and purchase of supply at beneficial rates.

### 1.2 Green Community Program Goals

In concert with the Town’s 2020 Energy Goals, in July 2008 the Massachusetts Legislature passed the Green Communities Act establishing a program to assist cities and towns on efforts to gain energy savings and reduce emissions. The Green Communities Program (GCP) goals are to maximize opportunities to save energy in schools, city halls, firehouses, and other public buildings; to generate some of their energy needs from wind, solar, and forest trimmings; and to make other decisions that reduce their environmental impact and carbon footprint

In order for a town to qualify and receive grants, loans, or other benefits from the GCP, it must meet five specific conditions:

- 1) Establish an energy-use baseline inventory for municipal buildings, vehicles, and street and traffic lighting, and put in place a comprehensive program to reduce this baseline by 20 percent within 5 years of initial participation in the program. [*Database development for benchmarking for buildings and lighting is underway, baseline for vehicles completed.*]
- 2) Purchase fuel-efficient vehicles for municipal use whenever such vehicles are commercially available and practical. [*Vehicle Fuel Efficiency Program already formulated, adopted and implemented, and can be expanded over time.*]
- 3) Establish As-of-Right siting in designated locations for renewable or alternative energy generating facilities, or research and development facilities, or renewable energy manufacturing facilities. [*Existing zoning allows manufacturing of renewable energy equipment by right in four districts: Light Industrial (LI), Light Industrial/Waterfront (LI/WF), Airport (AP), and Highway Commercial (HC).*]

*Under Green Communities Act requirements it will be necessary to provide a statement that ensures existing zoning applies to renewable energy manufacturing facilities. Additional changes to help manage energy development and protect the interests of the Town are included in draft by-law proposals.]*

- 4) Adopt an expedited application and permitting process under which these facilities can be sited within the municipality in less than 1 year from the date of initial application to final approval. *[This is within the current permitting process for the Town and can be ensured for energy generating facilities in the future by addressing standards and requirements in by-laws and the process for application, permitting and inspection.]*
- 5) Require all new residential construction over 3,000 square feet and all new commercial and industrial real estate construction to minimize, to the extent feasible, the life-cycle cost of the facility by utilizing energy efficiency, water conservation and other renewable or alternative energy technologies. *[This can be addressed in requirements of by-laws for life-cycle cost analysis submitted with new construction applications, as well as the process for review and permitting—adopting the state “Stretch Codes”.]*

### 1.3 Achievement of Goals

Achieving these goals means undertaking a comprehensive program for the Town that combines Energy Efficiency and Conservation, development of Wind Resources, development of Solar and other renewable energy resources. It also means developing an internal structure over time, or participating in a regional government effort, that will evolve to address changing market conditions, rules, and regulations.

On July 29, 2008 the Plymouth Board of Selectmen laid the cornerstone for such a comprehensive energy program by approving an Energy Officer for the Town and passing a resolution to undertake an energy efficiency campaign that will save money, jobs, and services:

#### ***Resolution To Initiate Energy Efficiency Campaign***

*In view of rapidly rising energy costs that affect Town budgets, the Plymouth Board of Selectmen resolves to initiate a new Energy Efficiency Campaign for all Town Departments. This effort will focus on policies, business practices, and procurement to ensure that the Town is receiving the maximum benefit for its energy spending. The Town Manager is requested to work with Department Heads to formulate and put in place measures and undertake actions that will accomplish this goal in an expeditious manner.*

By mid-2009, energy efficiency efforts for key municipal facilities were well on their way toward meeting initial goals and savings.

## 2.0 PLYMOUTH'S MUNICIPAL ELECTRIC USE

### 2.1 Key Municipal Facility Accounts

The Town of Plymouth has total annual electric usage of more than 18 million kilowatt hours (kWh). Schools account for nearly 70 percent of that usage. The School Department has already embarked on an energy efficiency program. The examination, accomplishments, and recommendations below focus on the 6.4 million kilowatt hours used by the key 42 accounts of municipal departments and facilities including town wells and street lighting. The combined cost of electricity for these major municipal electric accounts is more than \$1 million annually (\$1,164,830 at a cost of 16.8 cents/kilowatt hour for most facilities and 27 cents/kilowatt hour for street lighting).

**Figure 2 A**

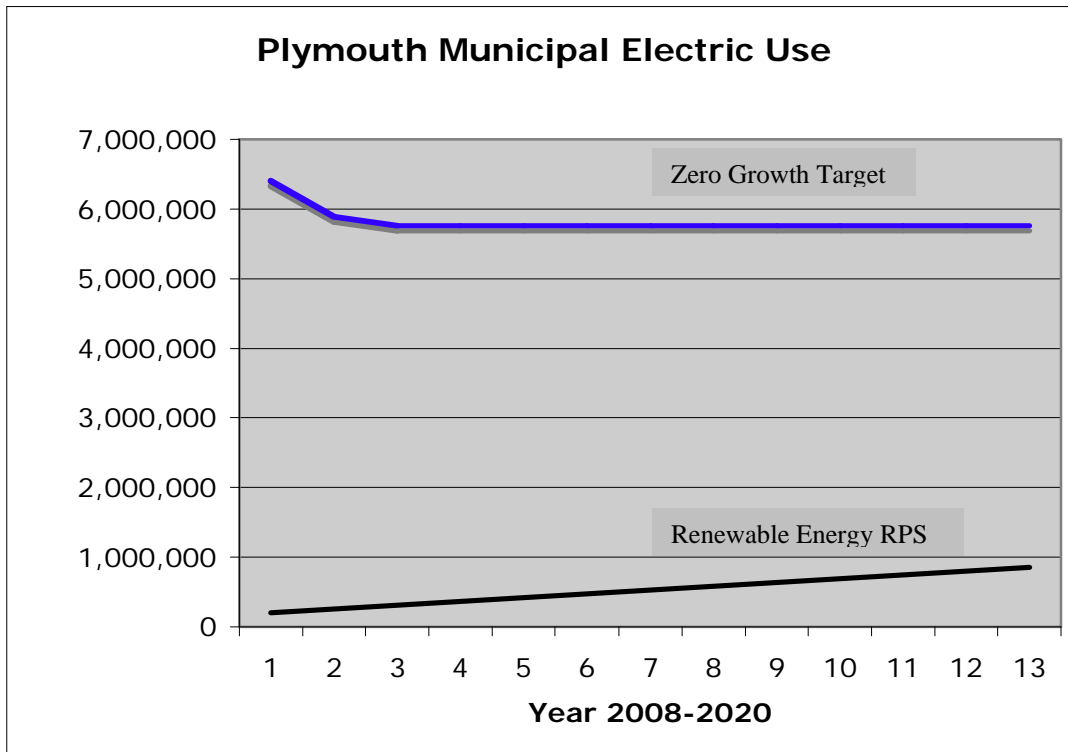
<u>General Category</u>	<u>Annual kWh Consumed</u>	<u>Annual Cost</u>
DPW-Managed Facilities	2,822,337	\$474,152
Water Department	2,027,072	340,548
Street Lighting	900,000	243,000
Fire Department Facilities	387,729	65,138
Miscellaneous Accounts	250,000	42,000
	6,387,138	\$1,164,830

### 2.2 Associated Emissions and Reduction Targets

The Green Communities Program has set a target for 20 percent reduction in a community's baseline energy usage within five years (2014). Hitting this target will also address the U.S. Mayor's Climate Action goal of a 7 percent reduction of emissions by 2012. Plymouth's municipal use of 6.4 million kilowatt hours each year results in carbon dioxide emissions (CO<sub>2</sub>) of 9,024,000 pounds annually from the NStar power supply. A 7 percent reduction of this "carbon footprint" would mean a reduction or displacement of 631,680 pounds of CO<sub>2</sub>. The least-cost option to achieve this is through energy efficiency measures and changes in operations and practices that reduce municipal usage by 448,000 kilowatt hours annually. Meeting this first target sets the Town on a great start toward the Green Communities Act goal of 20 percent reduction in baseline energy usage.

As noted above, the Town has officially embarked on a program that will reduce usage and develop or acquire green power supply. The program is on track with the identification of savings of approximately 9.4 percent of total electric usage (601,476 kWh) currently proceeding. An additional 2 percent or more is anticipated in the near-term from further energy audits and changes in practices and operations.

**Figure 2 B**



### 2.3 Overarching Electric Use Goals

**Energy Efficiency:** Reduction in use by 10 percent by 2010 (640,000 kWh) Zero Growth in Electric Consumption Campaign after that time with new energy efficiency offsetting new use.

**Cost Savings:** Reduction in use by 640,000 kWh saves approximately \$108,000 annually (with electricity at a cost of 17 cents/kWh)

**Resulting Carbon Reduction:** Saving 640,000 kWh reduces carbon emissions by 902,400 lbs. annually. This is in excess of the Energy 2020 U.S. Mayor’s Climate Action goal of 7 percent reduction (631,680 lbs.) and halfway to the Green Communities Act target of 20 percent by 2014.

**Green Electricity:** The goal to supply 100 percent of municipal load with “green energy” by 2020 is ambitious, but achievable. This can be done in a variety of ways through competitive supply, self-supply, or NStar supply. Renewable Portfolio Standards increase from 3.5 percent of retail supply in 2008 to 10 percent in 2015 and 15 percent in 2020. The least-cost supply could be a long-term contract from a green energy source (such as local wind turbines), or at the other end of the scale, NStar supply plus purchase of renewable energy credits above the 15 percent portfolio requirement to meet the goal of 100 percent green supply. If five or so utility-scale turbines are installed, electric load of the schools could be met in part by this “green” supply as well.

## 3.0 ENERGY EFFICIENCY AND CONSERVATION

### 3.1 Comprehensive Approach for Energy Efficiency

Plymouth’s forward-looking energy initiative reflects the growing movement among municipalities to take leadership to gain energy savings, protect budgets, save jobs and services, and preserve the environment. The most successful programs of this type take a comprehensive approach to electric usage that includes application of appropriate technology, adoption of optimum operational design, and working with employees to undertake best practices.

**Technology:** Technology is the nuts-and-bolts of efficiency measures—the central task is to make sure that the technology used is just what is needed for the facility or function. This includes sizing of motors and use of variable frequency drives; use of efficient bulbs, ballasts, and reflectors; and use of high-efficiency Heating-Ventilation-Air Conditioning (HVAC) systems. At a finer level it also includes room occupancy sensors, timers on lights, or programming of heating and cooling systems. Technology measures often mix longer-term payback applications with shorter-term payback applications to gain the deepest efficiency.

**Operational Design:** At one end of the spectrum operational design focuses on management of energy-consuming facilities, including use of equipment and workplace scheduling to optimize occupation of space and energy demand. It also includes understanding utility rates codes and charges as well as independent supplier charges. Changing schedules and functions can also create opportunities to reduce “demand” charges, or to shift usage to off-peak periods. Additionally, operational practices can mean altering the business format for energy consumption for a facility: ownership or lease of facility components such as street lights, or shared-savings with a private vendor who invests in the technology installed.

**Staff Practices:** Employee awareness and understanding is an essential part of maintaining and fine-tuning energy efficiency programs. Improving staff practices can include education and training on facility or equipment operation, or encouragement of simple acts such as shutting off lights or computers, or adjusting thermostats. Best practices need to be upgraded from time to time as new efficiency measures are installed or altered, or as usage changes. Establishing a committee or “Green Team” made up of different departments can support this shift in awareness and practices.

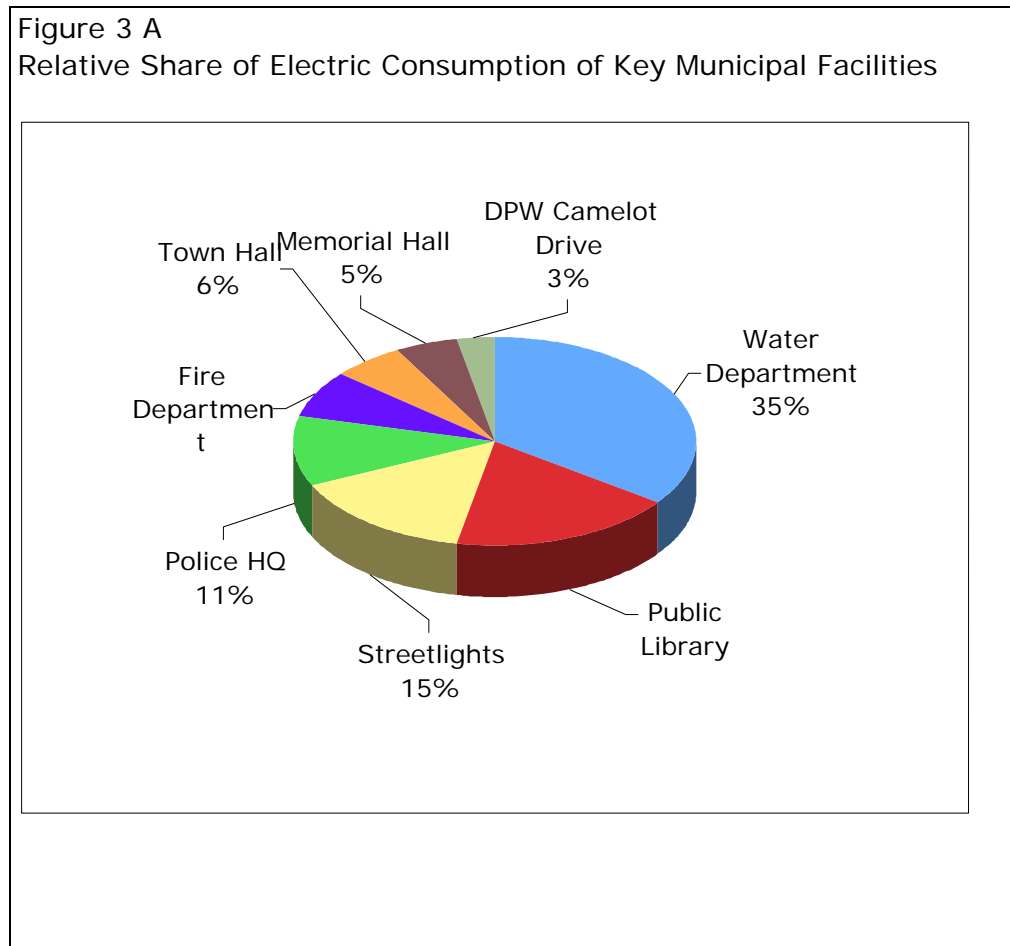
**Development of Data System:** Development of a billing and data system that can track and monitor changes in electric usage on a monthly (or time-of-use period if available) is essential to ensuring that initiatives and expenditures for energy efficiency and conservation are providing optimal benefits. This data system may be enhanced by software that can sort and provide closer monitoring of efforts to regulate specific facility uses.



Administrative Oversight: Timely monitoring, decision-making, and communication regarding any changes or adjustments needed in energy efficiency efforts is essential to energy efficiency program success. Periodic reviews are the cornerstone of this type of oversight. This can be conducted monthly or quarterly during an initial period and on an annual basis once the particular efficiency program is established.

The development of an energy efficiency and conservation program rests on an understanding of the Town of Plymouth's municipal electric consumption. Through this analysis, the top targets for improvement can be identified and efforts can be focused on gaining efficiency in these facilities as a first priority.

### 3.2 Targeted Energy Savings For Plymouth's Key Municipal Facilities



### 3.2.1 Water Department

The Plymouth Water Department consumes more than 2 million kWh annually at a cost of about \$340,000. The bulk of this use is centered on the Town's ten productive wells. As may be noted, Variable Frequency Drives (VFD), a technological component to increase the efficiency of pumping systems, were not installed on most of the wells. Following energy audits, VFD's were installed on four wells. An additional layer of auditing is needed for remaining wells and booster pumps.

**Figure 3 A Facility VFD Status**

Facility	Annual kWh	Existing VFD	New VFD Installed
Bradford Well	311,600	Yes	
North Plymouth Well	296,280	No	Yes
S. Pond Well #1	286,240	No	Yes
S. Pond Well #2	186,520	No	Yes
Savery Pond	242,267	No	
Ellisville Well	168,160	No	
Darby Pond Well	150,349	No	
Federal Furnace Well	144,831	No	Yes
Ship Pond Well	126,698	Yes	
Wannos Pond Well	114,127	Yes	
	2,027,072		

#### Initial Planning and Implementation Phase

*Recommended action was to undertake energy audits for targeted wells to examine costs and potential savings from installation of properly-sized motors and variable frequency drives for the pumps.*

#### Work Accomplished

*Audits undertaken for six well stations: North Plymouth Well, South Pond #1, South Pond #2, Federal Furnace, Ellisville, and Savory Pond. Analysis showed annual savings of \$45,718 could be gained with the installation of VFD's to control pump flow at the North Plymouth, South Pond #1 and #2 and Federal Furnace. Information submitted to NSTAR confirmed these findings. Under the NStar energy efficiency program, \$46,355 in consumer-funded rebates was offered to meet 50 percent of the total installation costs of \$92,710. The improvements are expected by NStar to reduce electricity usage by 225,206 kWh on an annual basis. Savings are expected to total \$45,718 annually for a less than one-year payback. Emissions reduction on an annual basis is estimated at 317,540 pounds. [Note this is 50 percent of Plymouth's target of 7 percent reduction of the U.S. Mayors Climate Protection Agreement.] Work was completed on these installations by June 2009. Work in cooperation with the Water Department should be conducted to prepare a five-year energy plan for Phase I. This plan would focus on further reducing electric usage or maintaining a target for no growth in electric consumption.*

### 3.2.2 DPW Maintained Facilities

The DPW oversees operation and maintenance of a variety of Town facilities. The primary electricity users which have a combined annual cost of about \$450,000 are noted below in Figure 3B. Energy audits for lighting in major facilities and change-outs of lights have recently taken place.

#### 3.2.2.1 Facilities

A focus at this time for major buildings is on Heating-Venting-Air Conditioning systems, especially for buildings that have older systems or display high costs.

**Figure 3 B Key Municipal Facilities**

Facility	Annual kWh	Audited
South St. Library	1,087,856	Yes
Police Headquarters	654,160	Yes
Town Hall	381,030	Yes
Memorial Hall	268,320	Yes
DPW Camelot Drive	196,540	Yes
Airport Admin Building #1	61,831	
Airport Sewage Treatment	130,000	
Town Hangar	42,600	
	2,822,337	

#### Initial Planning and Implementation

*HVAC audits were recommended for targeted buildings to evaluate costs and potential savings from system upgrades or enhancement.*

#### Work Accomplished

*Audits were undertaken for the South Street Public Library, Police Headquarters, Town Hall, Memorial Hall, and DPW Camelot Drive. The audit of the Library showed the heating system and cooling system were in conflict and driving high energy use. A new monitoring system, hot water VFD's and new electric motors showed an estimated savings of 249,803 kilowatt hours on an annual basis. NSTAR agreed with the findings and offered a combined electricity/natural gas rebate of \$64,100 toward the total project cost of \$144,825. The remaining funds were appropriated for the work, which has been completed. Estimated annual savings are \$73,108 annually, and estimated emissions reduction of 352,222 pounds of CO2. (This marks another 55 percent of Plymouth's total emissions reduction of the U.S. Mayors Climate Action target.)*

*Energy audits have also been conducted for Town Hall, Memorial Hall, and the Police Headquarters. The audit of Town Hall shows options for electric savings that total*

26,033 kWh. However only one electric measure, EMS Option 1, shows a reasonable payback period of 2.7 years for a cost of \$5,750 and a savings of 8,678 kWh.

The audit of Memorial Hall shows combined options that would save 117,791 kWh annually at a total cost of \$61,930. Rebates from NSTAR have not yet been estimated. Annual savings are estimated at \$34,417 and the payback period without rebates is less than two years. (The total kWh savings would be 26 percent of the U.S. Mayors Climate Action target.)

The audit of the Police Headquarters is currently being compiled, and the following facilities need to receive audits: Airport administration, hangar and sewage treatment operations; Fire Department facilities; Recreation facilities and lighting; and the Harbormaster’s facilities and operations. Examination might also be undertaken for removal of electric meters which have no current or anticipated future use for service.

A five-year plan for all Town facilities should be prepared with the cooperation of the DPW. Similar to the Water Department plan, this would be part of a campaign for “Zero Growth” in municipal electric consumption.

### 3.2.2.2 Streetlights

Street lighting represents a major use of electricity for the Town and nearly 900,000 kWh annually at a cost of approximately \$243,000. This presents significant opportunities for savings. In 2007, combined fixed charges and energy for street lighting cost approximately 27 cents kWh. In the past, analysis was conducted for the Town indicating benefits from purchase of the lamp and armature of each streetlight from NStar to reduce certain fixed charges.

Plymouth has a total of 2,560 streetlights and outdoor lights. Of these, 103 are mercury vapor lights (primarily 4,200 lumens), and 2,457 are high pressure sodium (primarily 4,000 lumens). Savings typically result from the difference in the fixed “luminaire” charge between NStar-owned lights and self-owned lights. (See Figure 3 C)

**Figure 3 C Streetlight Fixed-Charge Differential**

Number of Lights	NStar-Owned Luminaire Charge	Self-Owned NStar Charge
103 Mercury Vapor	each \$75.68/annual	each \$27.08/annual
1,787 HP Sodium rated 4,000 lumens	each \$61.22/annual	each \$17.42/annual
471 HP Sodium rated 5,800 lumens	each \$64.83/annual	each \$20.55/annual
199 SOD above 5,800 lumens	varies	varies

Additional savings can result from reducing other fixed charges. Savings are offset by the cost of purchasing the lamp and armature of each light (not the pole), and the cost of services under a private maintenance contract. NStar at one time offered separate maintenance contracts, but no longer does so.

Savings on fixed energy charges may also be augmented by savings from competitive supply of off-peak electricity for the streetlights.

#### Initial Planning and Implementation

*An initiative to re-examine and evaluate a process to purchase the streetlights is recommended. An initiative is also recommended to explore competitive supply of off-peak electricity for street lighting as a prelude to consideration of any other forms of Self-Supply.*

#### Work Accomplished

*Requested and received an inventory of streetlights. Met with NStar representatives and submitted a written request for NStar's estimated valuation of the street light armatures and lamps. No response has been received.*

*If not completed during Initial Planning, further efforts should be made to secure NStar's valuation. A thorough review of the valuation should be conducted and determination made on how to proceed in Phase I. Streetlights should be evaluated for replacement with LED lighting as that technology advances and costs come down. There is a potential for substantial energy savings.*

### 3.2.2.3 Traffic Lights

The DPW has instituted a program to change out the bulbs on traffic lights to LED lighting which will reduce consumption. LED traffic lights are brighter, have an average life of 6 years rather than 2 years which reduces maintenance costs, and use 80 to 90 percent less electricity than bulb lights. The typical payback period is 2-4 years. This savings has not yet been counted in total Town savings and should be monitored.

### 3.2.2 Fire Department

The Fire Department manages its electric accounts separately from the DPW. With total annual usage of approximately 387,729 kWh the cost is about \$65,000. As would be expected, headquarters shows the highest usage.

**Figure 3 D Fire Department Facility Annual Usage**

<u>Facility</u>	<u>Annual kWh</u>
Fire Department Headquarters	133,520
Station #2 Samoset Rd	73,600
Station #6 State Rd	52,649
Station #3 Pinehills Dr	42,960
Station #5 State Rd	36,154
Station #7 Spooner St	27,806
Station #4 Bourne Rd	<u>21,040</u>
	387,729

Initial Planning and Implementation

*Funding or technical assistance (perhaps through the Green Communities Program) needs to be committed to conduct energy audits for lighting and HVAC in Fire Department facilities.*

Work Accomplished

*The Fire Department has prepared an operational plan that incorporates energy efficiency. This can serve as a model for other departments.*

*Based on energy audits to be undertaken, the Fire Department plan should project technology improvements and anticipated savings as its portion of a five-year plan and Zero Growth in consumption campaign.*

3.3 Operation Design And Staff Practices for Energy Efficiency

3.3.1 Operational Plan

A *Policy and Administration Plan* was prepared to address operations and staff practices related to energy efficiency in the various Town departments and facilities. Day-to-day administration of the plan is the primary responsibility of the Town Energy Officer, the manager of facilities, and department heads.

The Town Energy Officer designated by and reporting to the Town Manager has oversight of the Town's municipal energy use. Among his/her tasks, the Energy Officer will review energy use data by facility/and or department on a quarterly basis and prepare an annual report regarding Town energy usage and costs. The report will be provided to the Town Manager and Board of Selectmen, with periodic updates to track any major changes. The annual energy report shall contain Town goals to control costs and consumption with the overall target of achieving the Plymouth 2020 Energy Plan goals. The annual energy report will also contain both past usage and projected usage for the

coming year to assist in setting energy budgets. It will note costs and savings (by department and/or facility). It will also include planned equipment replacements (by department and/or facility) and projected energy savings.

In addition to sharing responsibilities with department heads and the manager of facilities, the Energy Officer will work with the Energy Committee, consultants, and a “Green Team” made up of representatives from Town departments to implement efforts and achieve the identified goals. [See Separate *Green Program Development Plan*]

Department heads can direct questions regarding energy practices, policies, or equipment to the Energy Officer. Each department and facility should develop its own energy plan to design its own actions to reduce energy use.

The Energy Officer will also be in charge of implementing a Vehicle Fuel Efficiency program for the Town. [See Section 3.4 below]

#### Initial Planning and Implementation

*Analysis of Town energy use and a draft resolution to launch an energy efficiency program and appoint an Energy Officer was provided to the Board of Selectmen.*

#### Initial Work Accomplished

*The resolution was passed in July 2008. An Energy Officer was appointed and a Policy and Administration Plan was prepared. Based on the Policy and Administration Plan, space heaters were identified as equipment outside of efficiency and safety practices and removed from several departments. In addition to the energy audit of Town Hall, an air-balancing consultant was contracted to examine and replace thermostats and develop methods for heating and cooling the rooms in the building more effectively. A bench-marking system was also begun to track energy use by facility and department. This is essential to monitoring and reporting and the bench-marking system needs to be completed with all municipal accounts identified and included.*

*The Energy Officer also provided oversight for energy audits and formed an inter departmental “Green Team.” The “Green Team” set out to identify additional energy and environment-related savings opportunities within Town Hall.*

*The Energy Officer and “Green Team” in conjunction with the Energy Committee would develop the 5-year energy efficiency plan for Phase I and lead the Zero Growth in Consumption campaign.*

### 3.4 Vehicle Fuel Efficiency Plan

In addition to the primary focus on electricity use and savings, analysis was

prepared and a program recommended for achieving savings in motor vehicle fuel use. The specific purpose was to help develop a program that would result in reduction of fuel use and emissions. (See *Motor Vehicle Fuel Efficiency Program Report*, September 22, 2008.)

The Town's Vehicle Fleet represents a small local oil well for the saving it might produce. Like energy efficiency for electricity, the recommendations and program are geared to "right-sizing" of vehicles for the tasks and functions they must meet. The Town fleet was analyzed and the vehicles within department sub-fleets were categorized. The Town benefited greatly in the past from the practice of recycling Ford Crown Victorias decommissioned by the Police Department for use in other departments. However, while noted for its durability, the Crown Vic has low fuel efficiency for local driving (12 miles per gallon) which comprises 90 to 100 percent of use by many Town departments.

The report recommended expansion of the Town's general policy on motor vehicles [Municipal Vehicle Policy and Procedure]; enhancing administration and monitoring of the fleet and fuel consumption; utilizing the structure of an overall interdepartmental Vehicle Fleet and department sub-fleets to better advantage; encouraging departments to put vehicle plans in place with targets to reduce fuel usage; and purchasing high fuel efficiency vehicles based on life-cycle cost analysis.

#### Initial Planning and Implementation

*A part of the report, a dozen goals were recommended for the program. Among them, the general goal is for each department to utilize vehicles that provide the best service for the Town and its citizens at the lowest possible cost, while ensuring safety and comfort of the employee. A specific plan for increasing each department's vehicle efficiency and achieving a targeted reduction of fuel consumption (i.e. 10 percent in the first year) was recommended.*

*Life-Cycle-Cost-Analysis was conducted for vehicles under consideration for replacement with the results of the analysis and the report presented to the Town Manager and Energy Officer, the Finance Committee and the Board of Selectmen.*

#### Work Accomplished

*The program was implemented, achieving one of the requirements for qualification for the state Green Communities Program. Two new high fuel efficiency vehicles were purchased, and shared among departments.*



## 4.0 WIND ENERGY DEVELOPMENT

### 4.1 Plymouth's Wind Resource

As a coastal town, Plymouth has a rich wind resource, both on-shore and offshore. The Town also offers access to the electric transmission grid at several points. Which sites will be developed, and under what conditions, is an important matter not only for meeting Energy 2020 goals and Green Community Act qualifications, but also for managing development and the interests of the Town. If the Town's Vehicle Fleet represents a small oil well for the savings it can produce, the Town's wind resource is like a much broader oil field yet to be tapped.

A statewide wind map below shows comparative wind resources in Massachusetts at a height of 50 meters (See Figure 4 A). Plymouth's wind at 50 meters is shown in more detail on Figure 4 B. The quality of this resource increases one step in the scale by increasing the turbine height to 70 meters (See Figure 4 C), and another step in the scale by increasing the turbine height to 100 meters (See Figure 4 D). (Note FAA restrictions apply within the circled area on Figures 4 B- 4 D.)

**Figure 4 A Massachusetts Wind Resource Map At 50 Meters**

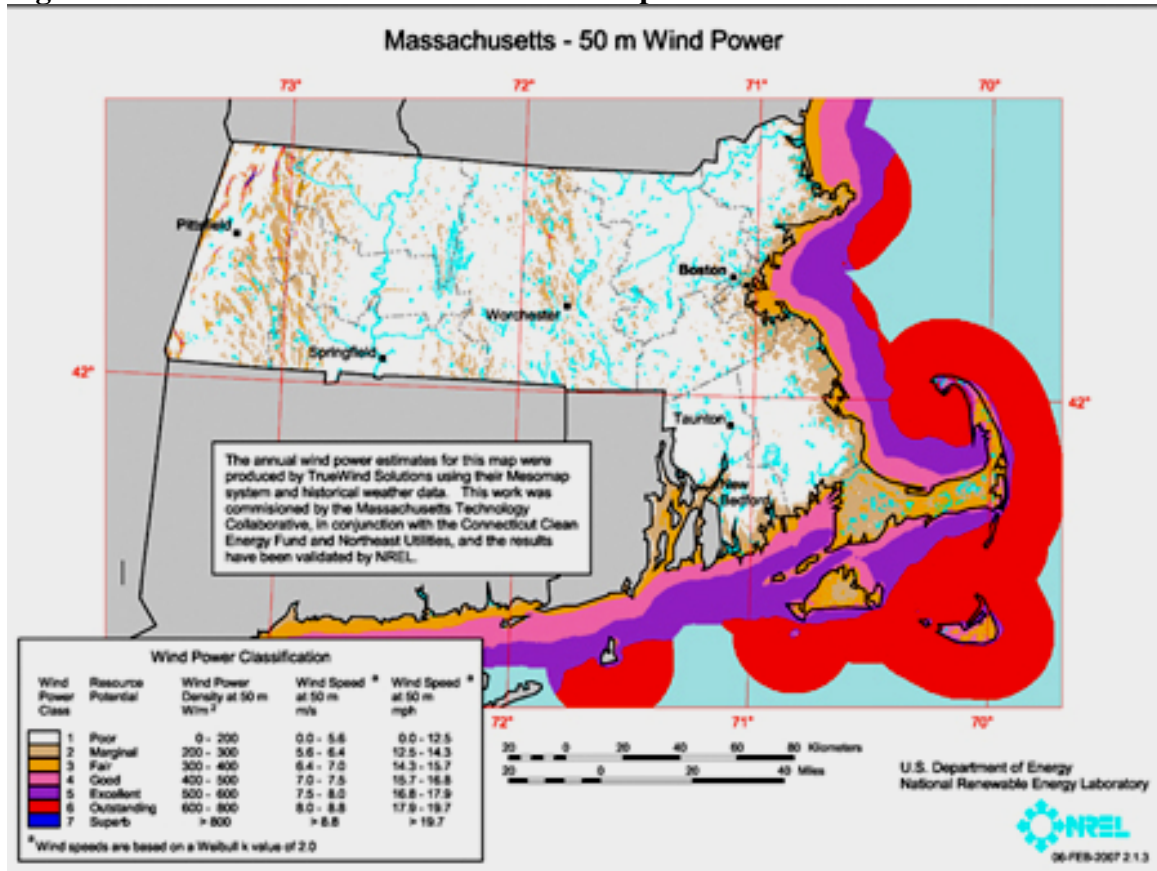


Figure 4 B Plymouth Wind Resource Map At 50 Meters

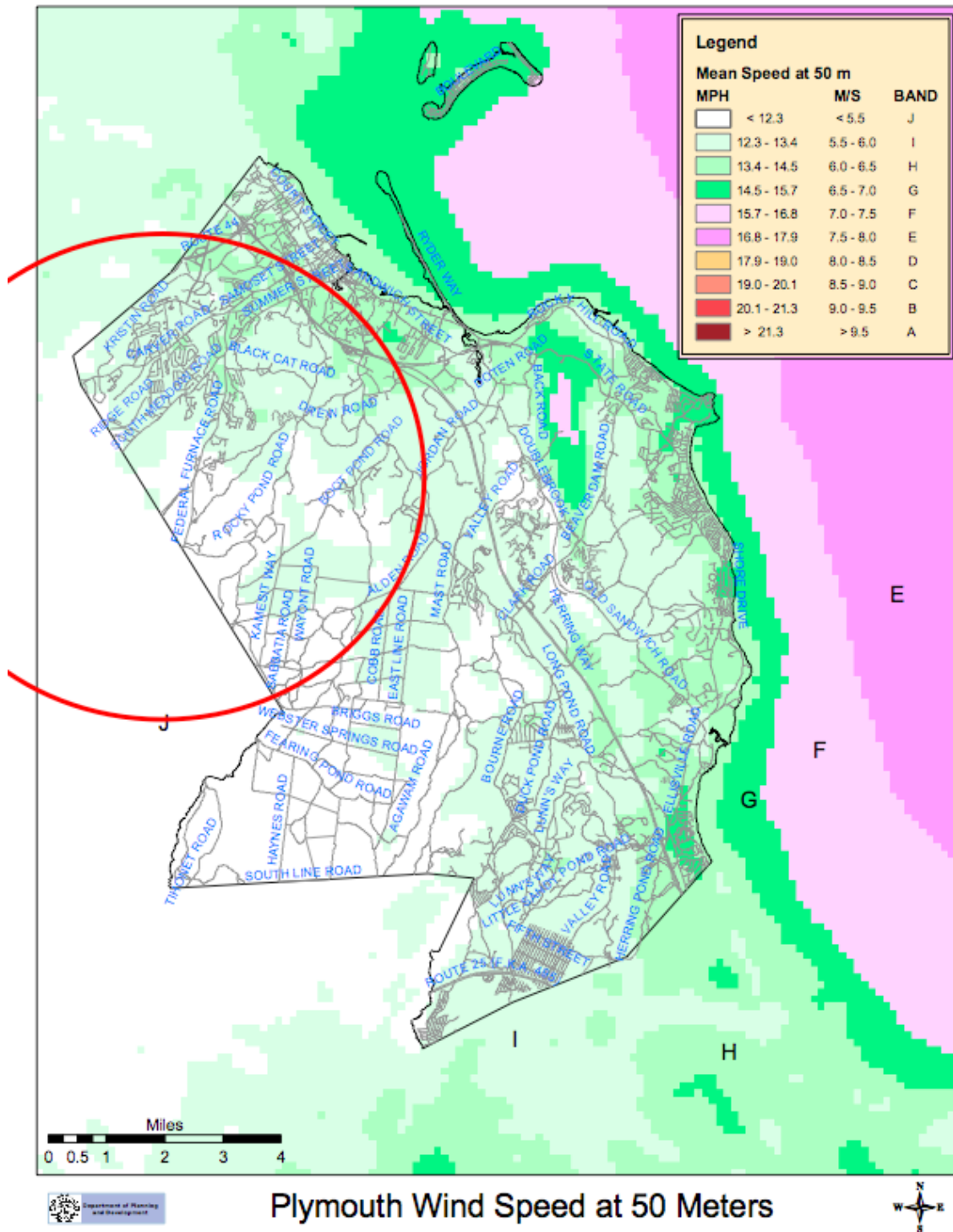


Figure 4 C Plymouth Wind Resource Map at 70 Meters

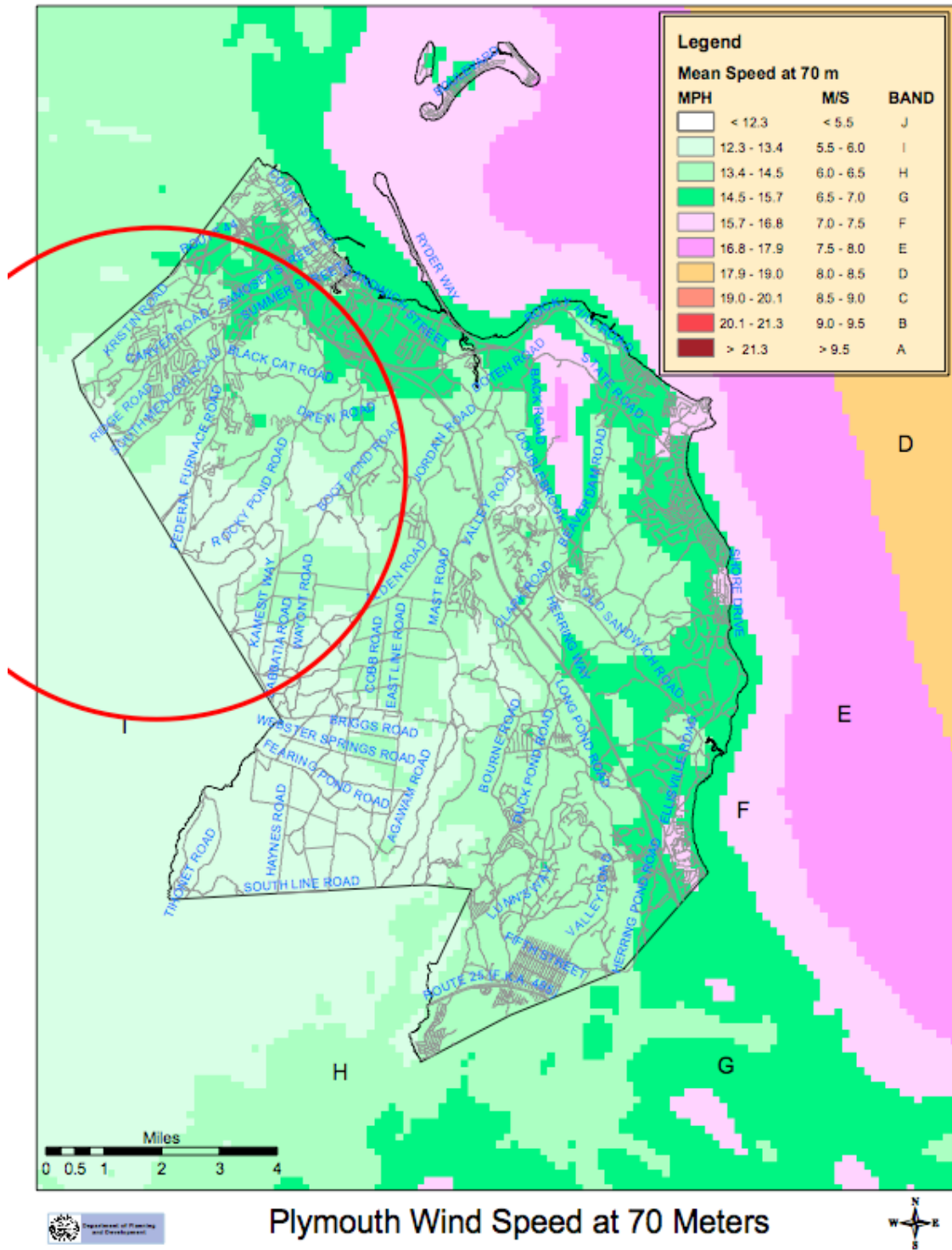
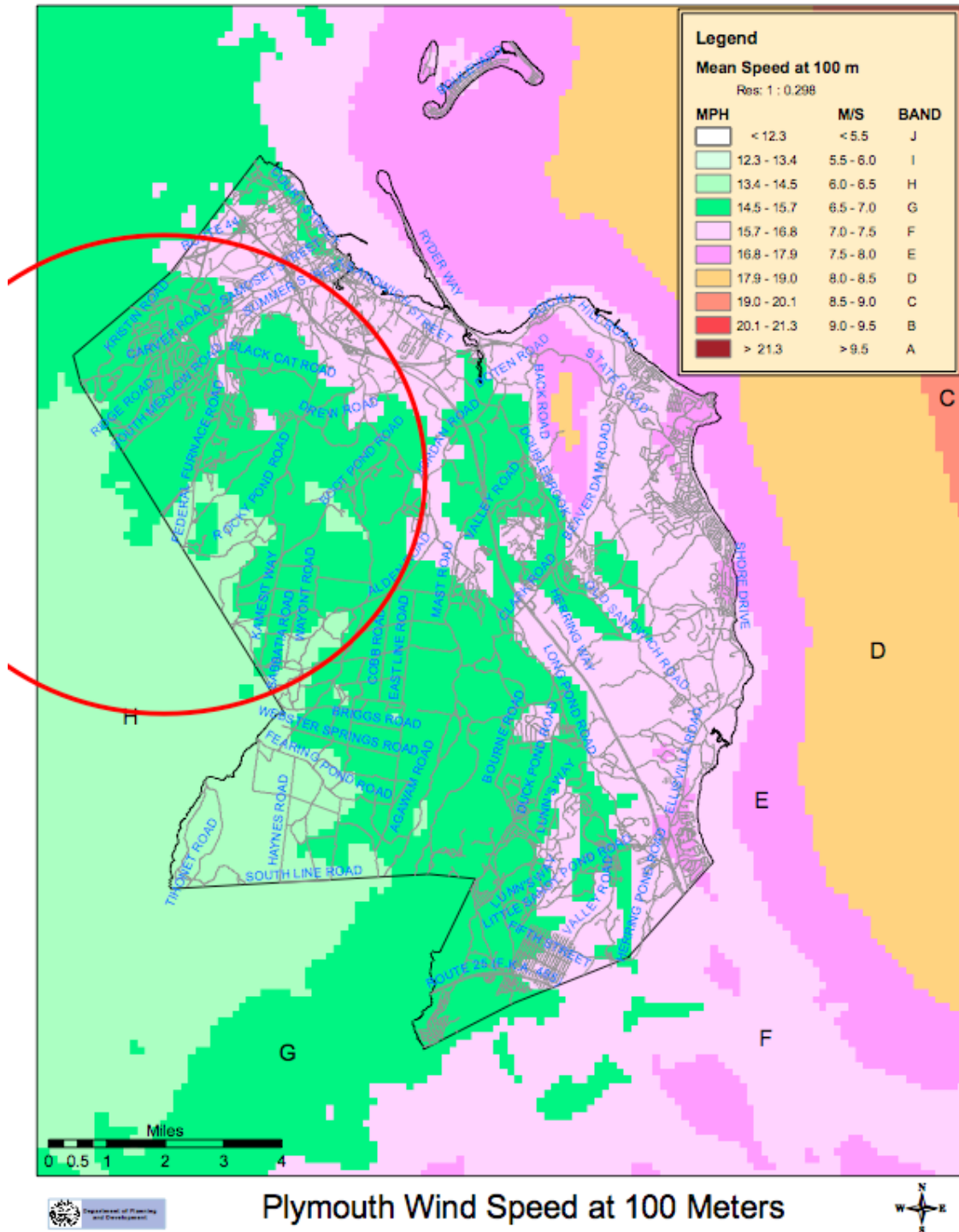


Figure 4 D Plymouth Wind Resource Map at 100 Meters



## 4.2 Examination of Specific Plymouth Sites and RFP

In 2006 initial analysis funded by the Massachusetts Technology Collaborative was conducted on seven municipally-owned parcels that were potential wind turbine sites. Of these, four were recommended for further investigation: the Waste Water Treatment Plant site, Indian Brook Elementary School, South High School, and Pine Hill. Wind analysis followed and an RFP for private wind turbine developers was issued for a lease of the Waste Water Treatment Plant site in 2009. Responses to the RFP included sale of energy to the Town. The two 2 megawatt turbines proposed could provide enough energy for all municipal needs, plus a portion of school electricity needs. This would meet the Energy 2020 goal for municipal “renewable” energy supply. Economic benefits would depend on the price of the wind-generated supply and comparable market rates, and whether Renewable Energy Credits are included with the sale, or sold separately by the wind facility developer.

Aside from this municipal site, a number of other private projects are currently in planning stages. As noted above, height restrictions of the Federal Aviation Administration (FAA) apply to an area within 20,000 square feet of the Plymouth Municipal Airport. Objects in this area must seek special permits if they are over 200 feet. This is indicated by the red circle on the preceding wind resource maps. It is important that the Town have a clear and expeditious process for managing the applications for construction of these and other projects.

## 4.3 Managing Wind Development

Given the growing interest in wind development, and the fact that the Town has a rich wind resource, it is important that changes in the Town’s by-laws be considered to manage development and achieve consistency with the Green Communities Program.

The Town currently has two by-laws (205-27 passed by Town Meeting in 1982) which appears to address small wind facilities, and (205-73 I) passed in 2005 and amended in 2006 which appears to address any facility from small wind turbines to utility-scale facilities. It is essential that distinctions be made for the development of “micro-wind” facilities, “small” wind facilities and “utility-scale” wind facilities.

To assist in this process, by-laws based on a Green Communities Program model have been drafted. These draft by-laws provide greater definition and clarity for the developer and the Town. (See model by-laws at Appendix A)

### Initial Planning and Implementation

*The wind RFP was reviewed and recommendations made; the 2006 analysis was reviewed; the existing by-laws were reviewed and the model by-laws drafted and discussed with the Town Energy Officer, Energy Committee, Town Planner, and Building Inspector. The local wind resource maps were prepared primarily by the Planning Office.*

## 5.0 RENEWABLE ENERGY

### 5.1 Solar Energy Systems

Solar systems include passive solar design to take advantage of natural heating and cooling of a building, solar hot water systems, and photovoltaic electric systems. This discussion focuses on photovoltaic systems.

Although Massachusetts does not enjoy the strong solar resource of areas like Arizona, New Mexico, and Southern California, high electric rates make the resource that does exist increasingly attractive. Advances in solar technology and business models are also expected to increase interest in solar development.

In one business model now emerging, private companies charge a consumer fixed costs over a lengthy time period (i.e. ten or twenty years) for installing a photovoltaic electric system. This can be attractive to commercial building owners with extensive roof area who are also interested in fixed costs and “green” marketing.

### 5.2 Plymouth’s Solar Resources

Plymouth has many municipal and commercial buildings with extensive roof space.

**Figure 5 A Commercial and Municipal Building Area Classification**

Commercial Buildings		
Class	Footprint Area (ft <sup>2</sup> )	Number of Buildings
1	676,808.9	5
2	527,196.2	8
3	723,888.0	21
4	620,316.5	40
5	195,665.3	23
6	400,796.8	65
7	448,454.4	126
8	252,317.2	175
Sum	3,845,443.3	
Municipal Buildings		
Class	Footprint Area (ft <sup>2</sup> )	Number of Buildings
1	288,176.8	2
2	321,755.1	5
3	118,412.4	3
4	265,179.5	17
5	71,023.5	8
6	28,545.9	5
7	45,570.6	14
8	42,493.1	43
Sum	1,181,156.9	



Among the many municipal rooftops, the Public Library on South Street and the Fire Department Headquarters on Sandwich Street offer good opportunities for projects that both produce energy and have educational value. The use of grant funds plus rebates from the Massachusetts Technology Collaborative's Commonwealth Solar program could support initial municipal projects, an option which is being explored.

Plymouth also has a few land areas (the former Cedarville and Manomet landfills) which may be suitable for a "brightfield", or ground-based array of photovoltaic panels. A Request for Proposals is currently being planned to offer for lease of portion of the Cedarville landfill (approximately 10.3 acres) and/or a portion of the Manomet landfill (approximately 17.6 acres). In the event that the Town has a platform for its own energy production, proposals that include a sale of output from the facility to the Town, and for an option to take over the solar brightfield for a fair market price after ten years of operation, are being requested.

### 5.3 Solar Planning and Development

Private development of solar photovoltaic projects currently take place under the Town's building code for accessory use. Plymouth has no zoning by-law provisions that specifically address solar energy systems. (The only specific conditions are set by the Plymouth Historic District which are appropriate to preserving historic character of the town's buildings. See section 2.4.2 below.) The development of specific by-law provisions that incorporate these essential protections can enhance planning, siting, permitting and installation of solar energy systems.

For example, at a broad planning scale, the layout of subdivisions and building orientation of new construction can be required to give consideration to solar orientation. At a more detailed scale, a specific solar energy system permit application form, may specify generic requirements and help to facilitate permitting. [See a draft Solar Energy zoning by-law provision at Appendix B.]

#### 5.3.1 Solar Planning

Massachusetts law gives local governments latitude to adopt solar access laws and requires that zoning not prohibit or overly regulate solar systems. M.G.L. Ch. 40A, section 3 states that no zoning ordinance or by-law shall prohibit or unreasonably regulate the installation of solar energy systems or the building of structures that facilitate the collection of solar energy, except where necessary to protect the public health, safety or welfare.

#### 5.3.2 Solar Easements

M.G.L. Ch. 40A, section 9B states that zoning may encourage use of solar energy systems or protect access to direct sunlight by regulating orientation, lots and buildings, height, setbacks and placement or trimming of vegetation. M.G.L. Ch. 187, section 1A allows special permits to be issued which create an easement to sunlight over neighboring

property, and provides standards for issuance of such permits to balance need for direct sunlight with neighboring property owners rights. These provisions can be incorporated into a local solar energy by-law.

#### Initial Planning and Implementation

*The Town's by-laws were reviewed and a Solar by-law drafted to encourage solar planning and development of solar facilities. The table indicating the raw footage of commercial and municipal building rooftops (including schools) was compiled primarily by the Planning Department, and analysis was conducted for photovoltaic systems for the Public Library and Fire Department Headquarters.*

## 6.0 ELECTRIC SUPPLY OPTIONS

### 6.1 Primary Considerations

The primary consideration of electric supply options is usually price of supply and determinations over what form of supply will provide the most savings over a set period of time. In view of Plymouth's 2020 goal to have 100 percent renewable energy for its municipal load, additional considerations also enter into decision-making.

Every retail electric supplier in Massachusetts is required to meet renewable energy portfolio standards (RPS) by having a specific amount of renewable energy in its supply mix. For 2009 that amount is 4.5 percent. In 2010 it is 5 percent and increases one percent per year through 2020 to 15 percent. For additional charges "green" power supply can be purchased from suppliers.

In order to meet both goals of savings and renewable energy, Plymouth is seeking an option that allows the greatest amount of latitude.

Massachusetts law allows several options for municipalities to participate in the retail or wholesale electric markets.

### 6.2 Variety of Municipal Electric Service Options

#### 6.2.1 Municipal Electric Systems

The traditional option for a municipality is establishment of a municipal electric system. Similar to a town water department, this typically includes ownership of all



electric facilities in the distribution system, purchasing supply at wholesale or generating power, and reselling to consumers, and providing all billing and customer service functions. A local commission sets rates for monopoly service based on wholesale costs and other expenses. Massachusetts has 40 municipal electric systems, all formed before 1927. The current provisions of Massachusetts law make this a difficult option to exercise.

### 6.2.2 Cooperatives

Similar to a municipal electric system is a “cooperative” electric system. Traditional electric cooperatives in rural areas have functioned since the 1920s to provide electric supply to members. They own distribution systems and many also own generating plants. As private non-profit organization, a cooperative elects a board of directors and sets its own rates. Massachusetts, historically, has had no traditional electric cooperatives, although several operate in Vermont, New Hampshire, and Maine. Provisions of the Massachusetts 1997 *Electric Utility Restructuring Act* allow the formation of a looser “cooperative” made up of corporate or individual members to conduct the business of buying and selling electricity. Municipalities, with proper local approval, can join such an organization and utilize the cooperative as a platform for a variety of energy activities, including participation in the wholesale electric market. After several years of experience in the retail electric markets, the Cape Light Compact (a municipal aggregation group—see below) is in the process of forming a “cooperative” to gain greater latitude to purchase and develop electric supply. Under such a cooperative form, NStar would still own the distribution system and conduct metering and billing services. NStar would also continue to provide energy efficiency services of the cooperative members.

### 6.2.3 Municipal Aggregation or “Community Choice”

Municipal aggregation is a third option, which was also made available to municipalities under the *Electric Utility Restructuring Act*. Most of the residential customers noted as receiving competitive supply in figure 1.1 (approximately 150,000 out of 250,000) are enrolled in the Cape Light Compact program operated by Barnstable County on behalf of Dukes County and the 21 municipalities on Cape Cod and Martha’s Vineyard. This is a retail supply program in which the Compact contracts with a competitive supplier to offer retail service to participating customers. NStar still owns the distribution system and provides metering and billing services.

Massachusetts law also allows municipal aggregators with power supply contracts to operate energy efficiency programs. The Cape Light Compact took over the energy efficiency programs formerly run by NStar, and manages \$5 million in funds contributed under a charge required of all customers in Massachusetts. The Massachusetts Department of Public Utilities has jurisdiction over the Compact’s Energy Efficiency Plan, as it does over those of utilities. The services under the program are delivered by vendors who also serve utility programs.

Formation of a municipal aggregation is best accomplished under a regional body which combines several municipalities. To design and operate an energy efficiency program it must have an aggregation plan being implemented to serve all classes of customers in the municipalities with retail supply.

#### 6.2.4 Private Brokers

Municipalities may also negotiate and contract with individual brokers who purchase electricity at wholesale and resell it at retail. These brokers are licensed through the Massachusetts Department of Public Utilities. Solicitation is carried out through an RFP process. For this retail supply NStar provides distribution, metering and billing, as well as energy efficiency services.

#### 6.2.5 Private Organization Aggregation

The Massachusetts Health and Education Facilities Authority (HEFA) offers a “Power Options” program as a service to its members. Government agencies, municipalities, and non-profit institutions are eligible for membership. Under this program, HEFA negotiates a generic contract with a supplier. Members query the supplier and prices are offered to based upon the member’s electric load characteristics. HEFA’s current contract is with Direct Energy and runs through May 2011. A contract may be signed for a term as short as six months, or for the duration of the Direct Energy contract. This is competitive retail supply in which NStar provides distribution, metering, and billing services. The Massachusetts Municipal Association offers a program similar to that of HEFA. HEFA members may also utilize the agency’s low-cost financing for purchase and installation of equipment or other energy efficiency measures. NStar provides distribution, metering and billing services for private aggregation, as well as energy efficiency services.

### 6.3 Range of Services

Figure 6A below outlines the various range of electric services available under each of the primary options. This is not intended to be a comprehensive listing of all services, but an indication of the primary latitude within each option. Combinations of these options may also be utilized to gain greater latitude in services, or as transitional platforms to develop services.

**Figure 6 A**

<b>OPTIONS FOR MUNICIPAL ELECTRIC SERVICES</b>					
	Municipal Electric System	Cooperative	Municipal Aggregation	Broker	Organization Member
<b>RANGE OF SERVICES</b>					
Power Supply	Wholesale	Wholesale or Retail	Retail Own Contract	Retail Own Contract	Retail
Rate-Setting	Authority to set rates	Sets rates via retail contract	Sets rates with DPU oversight	Contract	Contract
Customer Inclusion	All	Retail Members only	All who do not opt out	NA	NA
Energy Efficiency	Design and operate own program	Utility	Design and operate own program with DPU approval	Utility	Utility with loans
Renewable Energy Development	Design and operate own program	Design and operate own program	Design and operate own program	Individual	Individual with loans
Demand Response	Design and operate own program, or contract out	Design and operate own program, or contract out	Design and operate own program, or contract out	Contract out	Contract out
Streetlights	Own	Utility	Own/Utility	Own/Utility	Own/Utility
Distribution System	Own	Utility	Utility	Utility	Utility

#### 6.4 Scale of Commitment

Each of these options can require administrative and financial commitment on an increasing scale starting from an organization member purchase of retail supply in a pre-negotiated contract, up through the full scale operations of a municipal electric system. Similarly, development and implementation of each of the options requires funding, external expertise, and sustained effort on an increasing scale. Costs depend upon the complexity of the option and the range of services undertaken.

The lowest commitment level option using a member organization contract is often presented as perhaps not offering the lowest price, but stability for annual budgets. Data for the facilities to be supplied for a specified period are submitted to the contracted supplier (or suppliers) for the member organization, and a price is received with the pre-negotiated contract terms. The stability of fixed bi-lateral contract prices can be preferred by municipalities with annual budget constraints. Loans at discount rates may be available from the membership organization for energy efficiency or renewable energy development. Membership fees and/or the organization's charges added into the supply price are the primary costs of participation.

Purchasing independently from a broker or retail supplier through an RFP process allows an opportunity for tailoring of terms of contracts, and may offer an improvement in pricing over supply through a membership organization. Additional terms can include energy efficiency services, renewable energy development, or other services at reduced rates. The cost of this option includes market evaluation, RFP preparation, review of bids and negotiation of final contract terms. For this option, or others that independently seek supply, the option of a long-term bi-lateral contract with Entergy (now part of Enexus Energy Corp. which will operate the Pilgrim Plant) could be considered.

Development of municipal aggregation is desirable if the consideration is to include all customers in the municipality in the option for power supply. The option requires development of an Aggregation Plan and approval of the plan by the DPU. This is followed by market evaluation and release of an RFP and negotiation of a supply contract. The dimensions of risk are altered in taking on additional customers. Usually a core of "committed load" from a group of larger customers is required by a supplier. Design and operation of an Energy Efficiency program is also allowed if the municipality has a supply contract and a plan to serve all classes of customers. However the DPU prefers a large group of customers (several towns together) for economic operation of such energy efficiency programs. Municipal aggregation is limited to retail supply bids. The Cape Light Compact has had a difficult time attracting retail suppliers. Economies of scale can work for or against you depending upon the supplier and the customer composition. The same consideration of Enexus would apply as above. The cost of design and implementation of municipal aggregation works best when shared across a broad customer base.

Formation of a cooperative as a private organization working for the municipality offers a platform for access to wholesale supply. Participation in the wholesale market requires membership in ISO New England and the New England Power Pool, and a substantial degree of administrative experience as well as external technical support. While the benefits in purchasing from the Real Time wholesale markets can be greater during relatively non-volatile market periods, this option can offer the greatest downside exposure as well (as can be seen in the comparative pricing information of the last few months). The entities that have taken on this option have done so following several years of experience in retail market participation. Economies of scale are important to spread start-up and operational costs across a large group of customers. Participation is voluntary on a customer-by-customer basis. Adding customers can add to internal cash-

flow risk. The lag time between the week or less when wholesale power invoices are due to the ISO, and monthly payment from customers requires development of a financial source and deep line of credit. Design and implementation is complex and costly and works only if spread over a sufficient number of customer accounts.

A municipal electric system offers a broad platform for all forms of renewable energy development, energy efficiency. Supply is from wholesale sources with some similar risks as those facing a cooperative, however the risk is spread over a broad customer base. Aside from possible supply savings, benefits may accrue from reduction of some portion of operational costs that constitute approximately half the total charge per kilowatt hour of Basic Services. Establishing a municipal electric system requires long term commitment and substantial capital. The first step is a feasibility study which evaluates costs and benefits. If the feasibility study has affirmative results, an intensive educational and political campaign typically ensues as the local utility opposes a takeover and buyout of any portion of its distribution system. A common risk in implementation is that extensive funds are expended but a required local vote is not favorable. (See *Self-Supply and Other Power Supply Options* (August 1, 2008) for more information.)

## 6.5 Plymouth County Cooperative Option

Plymouth County is currently planning a regional energy entity in conjunction with the Middleborough Gas and Electric Department. The County would be interested in having municipalities participate as members. This would overcome barriers of cost for development and provide technical and administrative expertise through the municipal electric system. This option, if developed, could offer market leverage and other advantages for Plymouth and along with negotiations with Enexus for long term low cost power supply, the potential County cooperative should be examined as a platform for the Town's electric supply.

### Initial Planning and Implementation

*Market analysis was conducted on the Self-Supply and other power supply options as requested by the Energy Committee and a report prepared. Initial power supply analysis was conducted and comments offered on the Plymouth County Cooperative option.*

*The Energy 2020 goal of 100 percent renewable energy for municipal load can be met in a number of ways from supply from local wind turbines, to continued power supply purchase from NStar alongwith purchase of renewable energy credits above the utility's RPS. Determinations made on the form of power supply to be pursued will influence the long-term platform Plymouth might develop. Choice and development of a platform should be a key task for Phase I.*

## 7.0 EDUCATION

### 7.1 Town Employees and Staff

Undertaking successful energy efficiency programs and engaging in alternative

power supply requires a shift in operations as practiced in the past. It means changing perspective and overcoming myths about energy use. It also means expanding planning to include consideration of energy use as a fundamental operational feature. If a campaign for Zero Growth in Electric Consumption is to be mounted, each department will need its own plan. If employees and staff do not support the purposes of such plans, efforts could fall far short of goals and targets.

Policy needs to be clearly articulated, the purposes and goals understood, and practical information given to employees. Simple and brief formats for education are best: flyers, a fact sheet, or single fact placed in the right location, notes in employee communications can all reinforce effort toward an energy goal.

As noted in the *Green Program Development Report*, the use of a “Green Team” as a coordinating structure is vital to engaging and supporting efforts in each department. Having a comfortable workplace environment should be seen as a vital “green” issue—which involves heating, cooling and lighting. If employees experience direct benefits of green efforts, their support and participation in best practices is more likely.

Along with basic energy facts about a piece of equipment, lighting, heating or cooling, measurement of progress in saving energy and reducing costs is also a vital element to be communicated. As part of the initial planning and implementation phase, the facts and forms of communication should be identified and initiated as outlined in the *Green Program* report. A simple series of “Did You Know . . .” sheets or well-placed stickers on equipment can be very effective as a first step.

An effective communications plan and success with municipal facilities is the foundation of a broader educational effort for the general public.

## 7.2 General Public

A municipal energy program ultimately relies on public recognition and understanding of activities being undertaken. The Energy 2020 goals passed by Town Meeting, and the resolutions and other actions by the Board of Selectmen are testimony to an informed base of knowledge. It’s important to broaden this to the general public.

Engaging the general public can also involve fact sheets and stickers, information posted on a Website as a clearinghouse for energy information, specific information mailed to targeted groups, and presentations to the Chamber of Commerce or other organizations. Public progress reports should be issued as part of the reporting process. A standard media plan should also be prepared to publicize certain events or milestones reached.

## SUMMARY AND TIMELINE

The purpose of the Energy 2020 Framework Report is twofold: to help the Town qualify for participation in the Green Communities Program, and to set a path and timeline for reaching the Town’s short-term and long-term energy goals. The

Framework is intended to provide structure and at the same time allow flexibility to respond to evolution of rules, regulations and markets.

The Framework outlines development of the Town's energy program in three phases:

- 1) Initial Planning and Implementation Phase (2008-2010) described in the sections above. The key tasks are:
  - Establish a benchmarking and data system for energy use in all municipal facilities.
  - Conduct energy audits and undertaking facility upgrades based on the audits.
  - Formulate overall municipal goals for both Green Communities Program qualifications and Plymouth's Energy 2020 targets.
  - Appoint an Energy Officer and organize an internal "Green Team" to work with the Energy Committee.
  - Develop facility and departmental plans to help meet overall goals (such as a Zero Growth in Electric Consumption target).
  - Conduct analysis and releasing wind and solar RFPs to initiate development and renewable energy production on Town land.
  - Development and expansion of a Vehicle Fuel Efficiency Program.
  - Pursue grants, rebates, and other funding for municipal energy projects.
  - Undertake revision of wind and solar by-laws at the appropriate time to facilitate and manage renewable energy development and adopt state "Stretch Code" provisions.
  - Examine and make determinations on options for long-term power supply.
  - Put in place a monitoring and reporting system and develop and implement an educational plan for employees and the general public.
  - Develop a 5-year plan for Phase I based on experience and progress during the Initial Planning and Implementation Phase.
  
- 2) Phase I (2011-2015) based on monitoring and review of initial progress and a 5-year plan. The key tasks are:
  - Review and develop platform for power supply purchases or development.
  - Undertake a second layer of energy audits and implement energy efficient operations and practices.
  - Undertake determination on best practices for street lighting.
  - Participate in Green Communities Programs.
  - Review possible expansion of vehicle fuel efficiency and Green Team activities.
  - Conduct annual monitoring, and refine and set goals under a second 5-year plan for Phase II.
  
- 3) Phase II (2016-2020) based on Phase I determinations and a second 5-year plan, support development of additional wind and solar projects deemed to be in the best interests of the Town and its residents and businesses. If not before this time,

efforts should be made to examine and perhaps combine the energy efficiency programs for the schools and municipal buildings as well as electric supply for all of these Town facilities. Although administration and budgets would remain separate for the schools and other municipal buildings, a common team approach could boost savings and achievement of Energy 2020 goals for all Town facilities.

## APPENDICES



Appendix A Draft Wind By-Laws

Appendix B Draft Solar By-Law