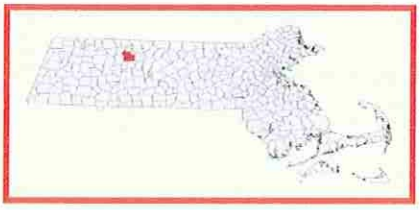
Town of Montague

Municipal Energy Reduction Plan

2008-2013



May 2010

Prepared by the:

Montague Energy Committee and

Montague Planning & Conservation Department

CONTRIBUTORS

This plan and the elements herein were compiled by the Montague Energy Committee and the Montague Planning and Conservation Department, with input from the following:

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EXECUTIVE SUMMARY

The Town of Montague seeks a future where it minimizes its impact dually on earth's climate and the municipal budget through the efficient use and generation of energy, energy that is safe, clean, ample, and helps sustain the economy. Through the Montague Energy Reduction Plan (ERP), the town joins a larger effort set forth by Massachusetts Department of Energy Resource's Green Communities Program. This plan is the final criteria for Montague's candidacy for Green Community Designation.

The Town of Montague has a goal to reduce the baseline municipal energy use by 20% by 2013.This plan, developed by the Montague Energy Committee and Montague Planning and Development Department, provides a blueprint of how to achieve that goal.

The plan uses FY 08 as an energy use baseline for municipal buildings, traffic lights, and vehicles. In order to reduce the baseline energy use, a series of planned reduction measures will be enacted to reach at least a 20% reduction by 2013. The plan utilizes MMBtu as a unit of measurement. This unit of measurement allows the town to aggregate energy use across a range of energy sources used by the municipality.

The ERP maps out a continuation and expansion of Montague's ongoing commitment to energy efficiency. in addition, Montague has been working to realize plans to tap its significant potential for renewable energy in the form of solar photovoltaic panels on municipal rooftops and on the landfill. Since 2008, the town has established an Energy Committee, obtained Clean Renewable Energy Bonds, commenced an Investment Grade Audit with a performance contractor, built an energy-efficient police station, developed a preliminary plan for photovoltaic panels on its safety complex, is fleshing out options for installing a large photovoltaic array on a portion of its landfill, and has replaced traffic lights to LED.

1 INTRODUCTION

Summary of Town

The Town of Montague (Pop. 8,480) is a small, diverse community located in northwestern Massachusetts, in the Connecticut River valley. The Town is conveniently located near major transportation routes (Interstate 91 and Route 2) and is served by a municipal airport (Turners Falls Airport). Montague was incorporated in 1754. The Town is governed by a Board of Selectmen and has a representative form of town meeting. There are also several overlapping political jurisdictions within the town, including fire districts, water districts and lighting and school districts. Montague's electricity is supplied by Western Massachusetts Electric Company, natural gas by Berkshire Gas Company, and home heating oil by Sandri Oil Co.

Goal of Reducing Fossil Fuel Energy Use

The goal set forth in this plan is to reduce municipal energy use by at least 20% in the next five years. This goal is a component of Montague's candidacy for Green Community Designation, for which all of the criteria have been met. The plan is consistent with Montague's track record as a leader in municipal energy efficiency. Montague has previously endorsed the Pioneer Valley Clean Energy Plan, which has a goal to reduce Pioneer Valley and Franklin County energy consumption by 15% between 2010-2020.

Facilities and Vehicles

This plan addresses the energy consumption of municipally-owned and -operated buildings, lights, and vehicles and two municipally-owned elementary schools that the Town leases to the Gill-Montague Regional School District. Departments included in the study are Police, the Department of Public Works, the Turners Falls Municipal Airport Commission, Town Hall Administrative Offices, Water Pollution Control, the Libraries, and Parks and Recreation.

Not included in the scope of this study is the Gill-Montague Regional School District (with the exception of the two town-owned school buildings), nor any of the "prudential committees". These independently operated entities are the Turners Fall Fire District, Turners Falls Water District, Montague Center Fire District, Montague Center Water District, and the Montague Center Lighting District. Although combined, these districts include a significant portion of municipal energy use, the Town of Montague has no regulatory authority over their management, and they are therefore not included in the plan.

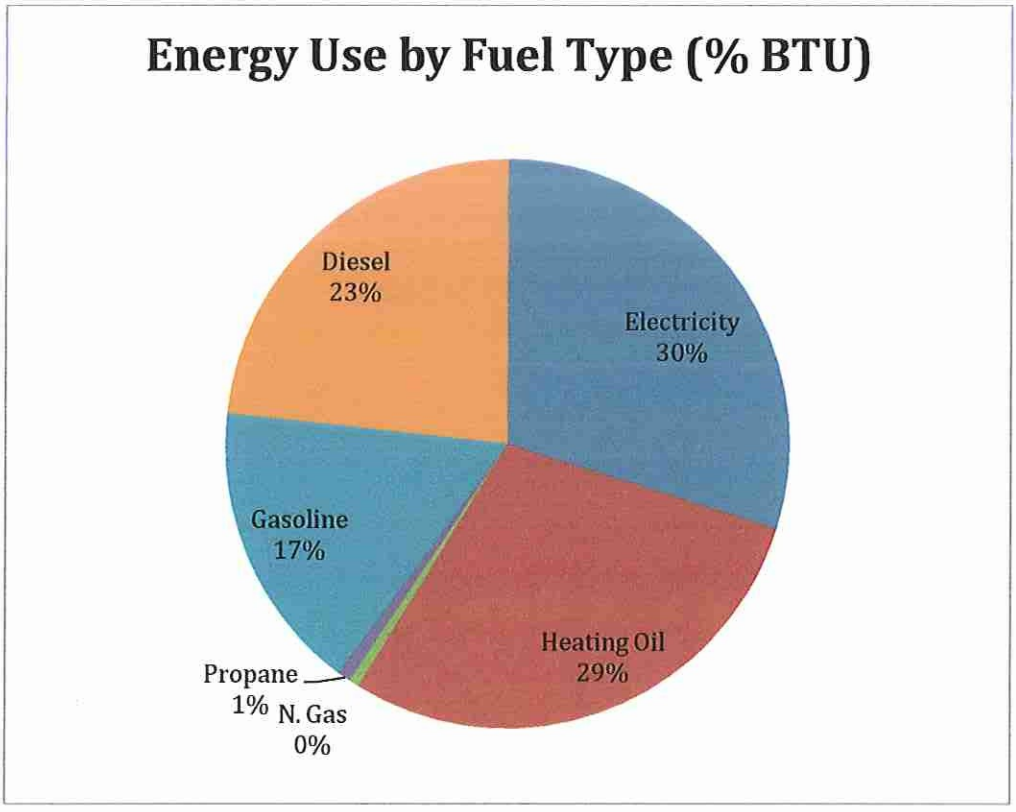
Also not included are buildings under lease to the municipality such as the senior center, nor are vacant municipally-owned properties. Buildings that the municipality leases to others, such as the Shea Theater, where the occupant pays utilities, are not included. The Colle Opera House is included in the scope because the town leases the property but pays the utility bills. Traffic light utilities are paid by the DPW and are included, but streetlights are provided by various prudential committees and are not included.

Building Name	Department	Address	Sq. Ft.	Year Built	Heat Fuel
Airport	Airport Commission	Millers Falls Rd	768	1996	oil
Town Hall	Town of Montague	1 Ave A	13,000		oil
Town Garage	Department of Public Works	500 Ave A	19,000	1949	oil
Unity Park Field House	Parks and Recreation	56 1st St	4,000		propane
Hillcrest Elementary	GMRSD	30 Griswold Street	34,438		oil
Sheffield Elementary	GMRSD	43 Crocker Avenue	110,163		oil & natural gas
Millers Falls Library	Libraries	23 Bridge St	1,320		oil
Carnegie Library	Libraries	201 Ave. A	2,700	1905	oil
Montague Center Library	Libraries	17 Center St			oil
Water Pollution Control Facility	Water Pollution Control	34 Greenfl'd Rd.	16,000	1964	oil
Colle Opera House	Town of Montague	85 Avenue A	19,200		NG
Recycling Center*	Department of Public Works	Sandy Ln	1,200		electric
Traffic Lights	Department of Public Works	n/a	n/a	n/a	n/a
Municipal Vehicles	Police, DPW, WPCF	n/a	n/a	n/a	n/a

*Recycling Center includes a 1,200 garage, a 14X24 ft shed, a kennel, and the fuel tank.

Baseline Inventory

In the past, the Town of Montague has not tracked energy usage data. The Planning and Conservation Department has now taken on this duty. For this plan, the data was collected manually. But with advancements in energy tracking software, such as Mass Energy Insight, this task will become much easier. Concurrent with the creation of the baseline, the Town of Montague has sent a delegate from the Planning and Conservation Department to training for this energy tracking software. The town is in the process of transferring the utility data into the software. The Town intends to utilize Mass Energy Insight for future energy tracking and verification of reductions. The Plan uses fiscal year 2008 (FY08) for the baseline inventory year. The user of this plan should account for several anomalies associated with the baseline year. FY 08 experienced record high accumulations of snowfall, which increased the demand for diesel and heating oil beyond budgetary anticipations. Also, a public safety complex housing police and fire has been constructed and opened since the baseline year. Police were located in the Town Hall during the baseline year.



Energy Reduction Strategies

The principle strategy to reduce municipal energy use over the next five years is through an energy services performance contract (ESPC). The Town of Montague has entered into a contract with Siemens Building Technologies (Siemens) for an investment grade audit (IGA). Siemens has completed a scoping/preliminary energy audit of town owned buildings. The Town is now in discussions with Siemens regarding expanding the scope of the investment grade audit and the subsequent energy services performance contract. The Town wishes to add the two town-owned elementary schools into the Town's performance contract project. Under a separate agreement between Siemens and the Gill-Montague Regional School District (GMRSD), Siemens has also completed a scoping/preliminary energy audit of these two school buildings.

The Energy Service Company (ESCO) Performance Contracting Program is a turnkey program whereby private ESCOs undertake the study, design, and installation of conservation measures to upgrade existing Town facilities' building systems at no up-front capital cost to the community. The company performs in an-depth energy audit and identifies energy saving measures for municipal facilities. The work that is contracted by the Town will be paid for out of the energy savings, so there would not be any up-front costs to the Town. Additionally, the savings are guaranteed by the energy audit company to cover the cost of improvements.

Specific energy reduction recommendations included in the reduction plan will include the energy saving measures suggested in the ESCO IGA, as well as additional measures to increase the energy efficiency of other buildings, vehicles and lights. These will be coupled with various renewable energy initiatives including the installation of about 60 kW of photovoltaic panels on City buildings, for which the Town has been authorized to issue $199,000 worth of Clean Renewable Energy Bonds. The Town is also examining the potential for a large photovoltaic array on the Town's landfill.

2 RESULTS OF ENERGY USE BASELINE INVENTORY

Inventory Tool Used

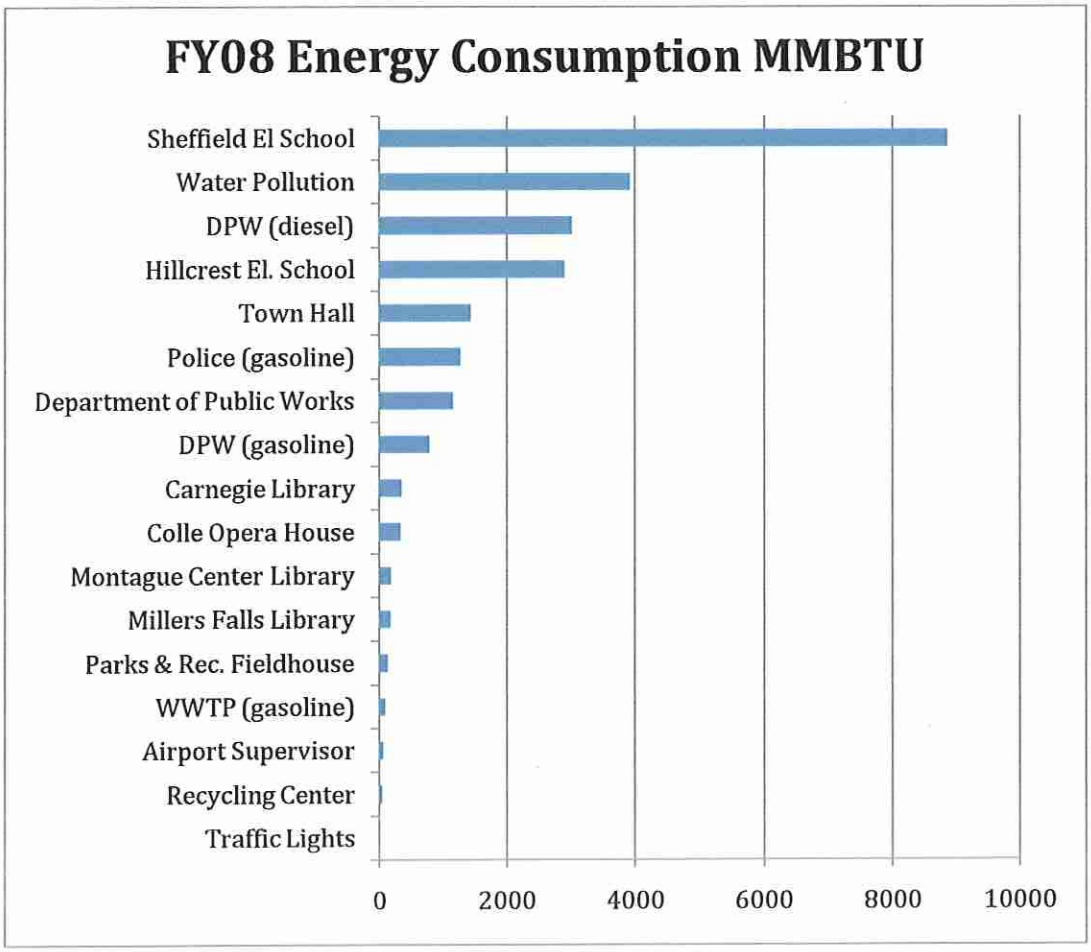
The Montague Planning and Conservation Department developed in-house the energy inventory method used. Prior to this plan, the Town of Montague had not tracked energy usage data. A Microsoft Excel spreadsheet was developed, and energy use data from all departments was manually entered into the spreadsheet. The Investment Grade Audit served as a starting point for the municipal inventory.

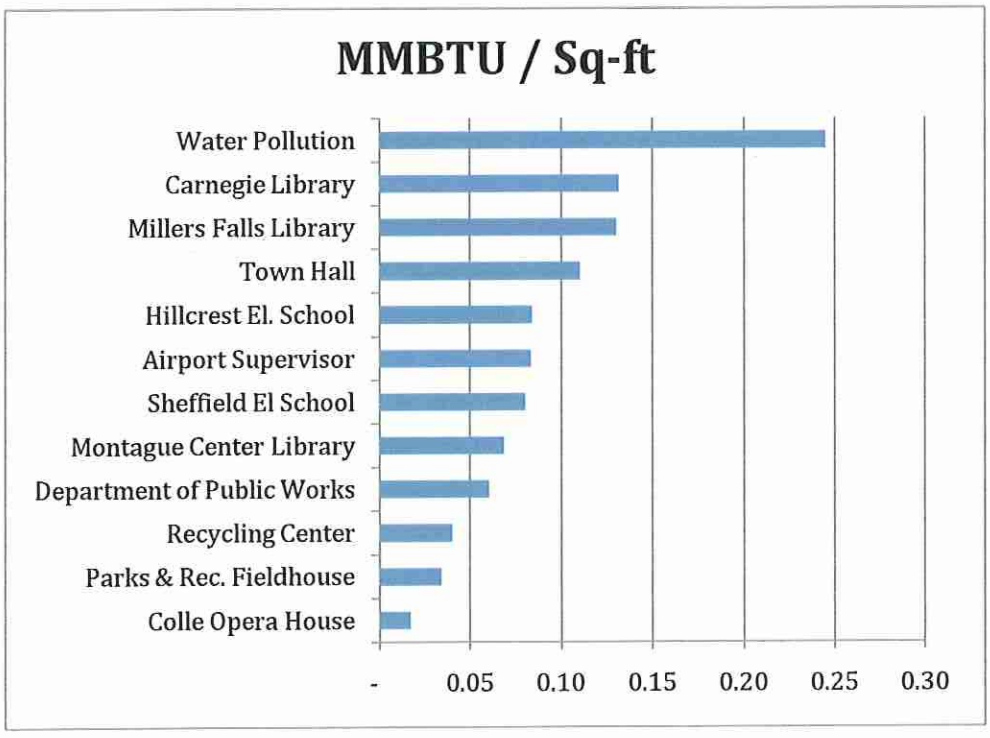
Concurrent with the creation of the baseline, the Town of Montague sent a delegate from the Planning and Conservation Department to be trained in the use of DOER's MassEnergy Insight program and plans to shift to this program for ongoing monitoring of municipal energy use.

Baseline Summary

FY08 Baseline Inventory

	kWh	Oil (Gal)	N. Gas (Therms)	Propane (Gal)	Gasoline (Gal)	Diesel (Gal)	MMBTU
Town Hall	146,806	6,711					**1,434**
Department of Public Works	31,679	7,512					**1,152**
Parks & Rec. Fieldhouse	10,113			1,120			**136**
Montague Center Library	5,561	1,196					**185**
Millers Falls Library	8,961	1,020					**172**
Carnegie Library	28,928	1,842					**355**
Water Pollution	791,920	8,770					**3,921**
Airport Supervisor	11,763		234				**64**
Colle Opera House	80,150		538				**327**
Recycling Center	14,009						**48**
Sheffield El School	276,933	40,365	23,086				**8,864**
Hillcrest El. School	107,099	18,235					**2,900**
Traffic Lights	4,680						**16**
Police (gasoline)					10,270		**1,273**
WWTP (gasoline)					769		**95**
DPW (gasoline)					6,350		**787**
DPW (diesel)						21,745	**3,023**
TOTAL	**1,134,570**	**27,051**	**772**	**1,120**	**17,389**	**21,745**	**24,753**


FY08 Energy Consumption MMBTU
Sheffield El School
Water Pollution
DPW (diesel)
Hillcrest El. School
Town Hall
Police (gasoline)
Department of Public Works
DPW (gasoline)
Carnegie Library
Colle Opera House
Montague Center Library
Millers Falls Library
Parks & Rec. Fieldhouse
WWTP (gasoline)
Airport Supervisor
Recycling Center
Traffic Lights
0
2000
4000
6000
8000
10000


MMBTU / Sq-ft
Water Pollution
Carnegie Library
Millers Falls Library
Town Hall
Hillcrest El. School
Airport Supervisor
Sheffield El School
Montague Center Library
Department of Public Works
Recycling Center
Parks & Rec. Fieldhouse
Colle Opera House
-
0.05
0.10
0.15
0.20
0.25
0.30

The Wastewater Treatment Facility and Elementary Schools are by far the largest municipal energy consumers.

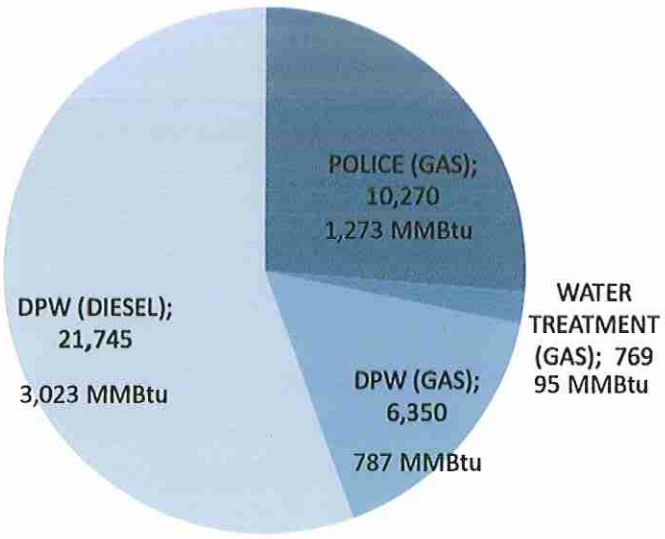
Among the Town's other least efficient municipal buildings are the Carnegie Library, the Millers Fall Library, and the Town Hall.

Vehicle Baseline

The Montague DPW is the fuel depot for fueling of most municipally owned vehicles. In FY 08, the fuel depot supplied fuel for the Police Department, Water Pollution Control, the DPW, as well as for several prudential committees excluded from the baseline. It should be noted that the Police Department no longer purchases fuel from the DPW and now uses a credit system with Cumberland Farms Corporation. It should also be noted the FY 08 was a heavy snow season, resulting in inflated usage of diesel fuel.

	Fuel	Gallons		cost	MMBtu
POLICE	gas	10,269.6	$	31,117	1,273.4
WATER TREATMENT	gas	769.4	$	2,331	95.4
DPW	gas	6,349.7	$	19,240	787.4
	Diesel	21,745.2	$	58,712	3,022.6
TOTAL		17,388.7	$	111,400	5,178.8

Municipal Vehicle Fuel Usage FY08 (Gallons)



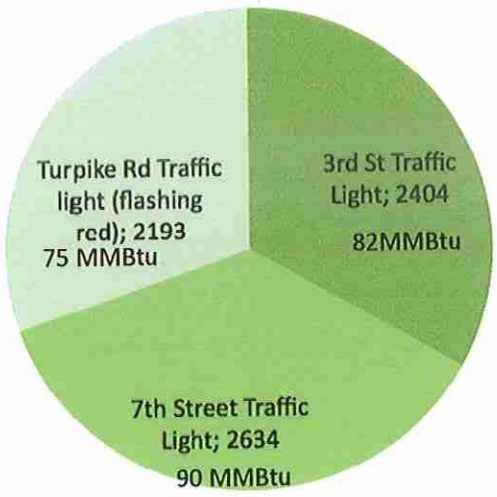
Diesel fuel accounts for 56% of the municipal vehicle demand. The Department of Public Works is the largest consumer of fuel for the municipal fleet. 77% of the DPW's fuel usage is diesel fuel.

Traffic Light Baseline

There are three permanent traffic lights in Montague. They are operated by the Department of Public Works. Full signal rotation lights are located at 3rd Street and Avenue A and 7th Street and Avenue A, and a flashing red is located on Turnpike Road at the corner of Turners Falls Road. The full signal rotation lights had LED lights installed in 2007.

	Use (KwH)	MMBtu	Annual Cost
3rd Street Traffic Light	2,404	82	$ 679
7th Street Traffic Light	2,634	90	$ 709
Turpike Rd Traffic light (flashing red)	2,193	75	$ 672
Total	*7,231*	*247*	*$ 2,060*

Traffic light energy usage (kilowatt hours)



All three lights use a similar amount of energy. The two full signal traffic lights use slightly more energy, even though they are LED lights, while the Turnpike Road is not LED lighting.

Baseline Adjustment

In order to account for energy savings from the Town's decision to install a high-efficiency ground-source heat pump system at the new Police Station, instead of a conventional HVAC system, adjustments to the baseline are needed. The baseline must be adjusted to reflect the energy that the police station would have used if a conventional HVAC system had been installed, before the Town can take credit for reduced energy use by choosing to install a high-efficiency ground-source heat pump system.

The Town's commissioning agent has calculated that, based on the new Police Station's first year heating performance and calculated first year's cooling performance, compared to a code-compliant conventional HVAC base case, the new Police stations geothermal HVAC system is using 362 MMBTU less energy. Therefore, the baseline energy use must be adjusted up by 362 MMBTU to 25,115 MMBTU.

EXISTING EFFECIENCY MEASURES IMPLEMENTED IN THE LAST 2 YEARS

EXISTING ENERGY CONSERVATION MEASURES	Building	Date Implemented	MMBTU Savings	% Baseline reduction
4 Day flex work week at Town Hall	Town Hall	August 2008	287*	1.1%
LED Traffic Lights at 3rd+A and 7th+A	Traffic Lights	July 2007	37*	>0.1%
Geothermal versus conventional HVAC in New Police Station	Police Station	2009	362	1.4%

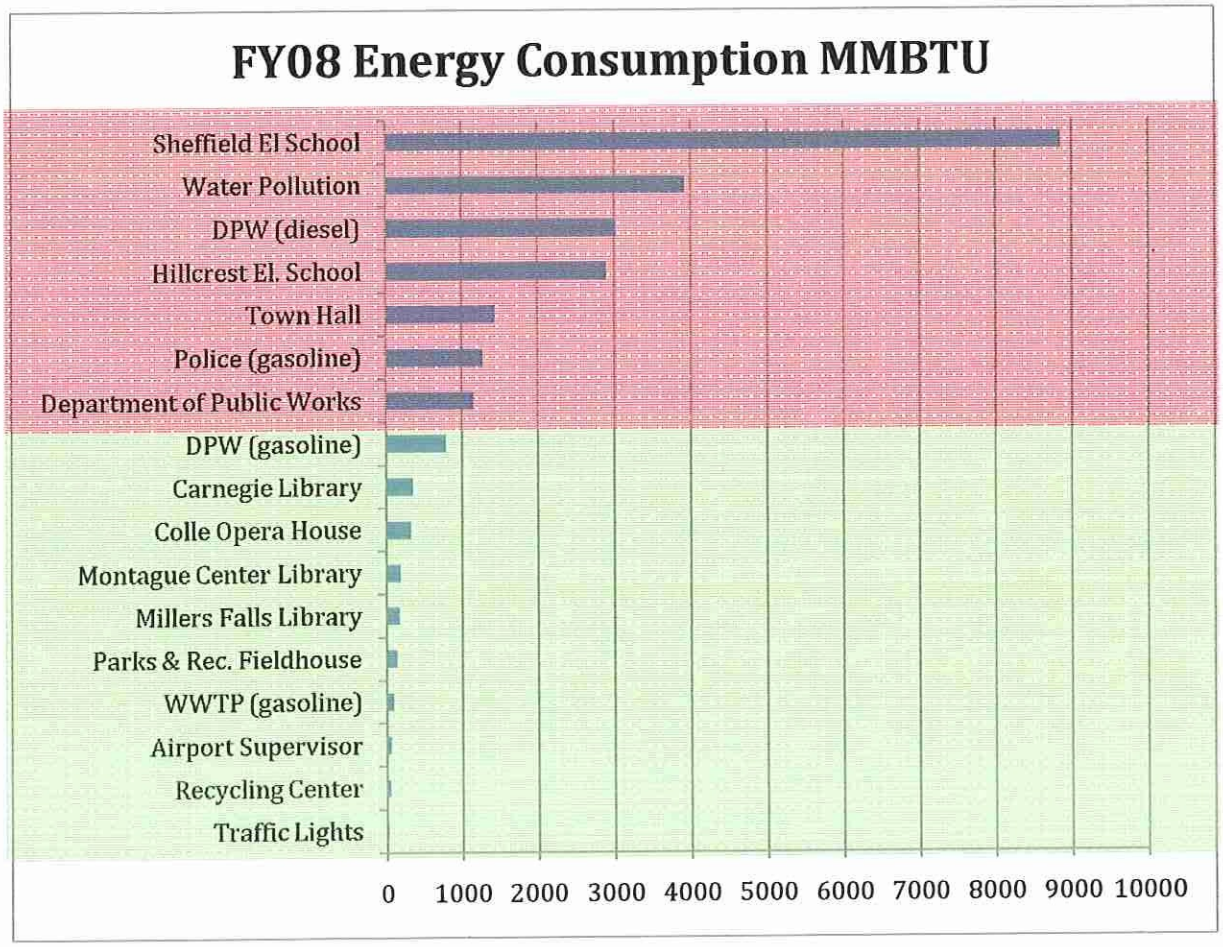
*estimates

The largest energy efficiency measure taken by the town of Montague is the 4 day flex work week at Town Hall. This measure was implemented specifically to reduce energy consumption. The energy reduction is not reflected in the baseline because this policy was implemented just after the FY08 baseline year.

In the summer of 2007, the DPW installed two LED traffic lights on Avenue A. The energy savings are minimal but a step in the right direction.

A new police station was built since the baseline year. The Town chose geothermal over conventional HVAC. The figures were provided by the commissioning agent for the building.

Town Energy Users From Most to Least Consumption



The energy users highlighted in red comprise 91% municipal energy use. The heaviest energy users in Montague are the Sheffield School (36%), the Water Pollution Facility (16%), DPW diesel 12%), the Hillcrest School (12%), Town Hall (6%), police vehicles (5%), the DPW garage (5%), and DPW gasoline (3%). The remaining energy users are individually 1% of the baseline or less.

Areas Most Easily Addressed

Energy efficient behavior has begun to take hold in Montague. Town Hall and DPW already work a four day flex week, but we look to expand beyond behavior. The performance contract project is expected to achieve sizable energy use reductions in one comprehensive package, and converting to a blend of biodiesel is a relatively easy step to take. Difficult to address are the overall amount of fuel used by the police department and DPW, as most of their vehicles are GCA exempt.

3 Summary of Investment Grade Audit

Siemens has begun an Investment Grade Audit (IGA) of municipal building sin Montague. In projecting current energy use and future savings, Siemens is utilizing FY08 as a baseline. At the time of the adoption of this plan, Montague has received from Siemens an Investment Grade Audit Initial Findings Report. Most municipal buildings are included in the Initial Findings Report: Town Hall, the Parks and Recreation Fieldhouse, the Millers Falls Library, the Montague Center Library, the Water Pollution Control Facility, the DPW garage, and the Carnegie Library. The IGA evaluated each of these building's lighting, sensors, building envelope, and heating systems and proposed energy efficiency conservation measures.

CURRENT STATUS OF IGA

The Town and Siemens are in discussions over the scope of the final IGA and construction timing. The Town would like to add the two Town-owned elementary schools to the final Investment Grade Audit, and there is a need to complete at least one ECM, replacement of the Town Hall boiler, this summer. The Town will most likely move forward in two phases, with phase one to include at least an energy efficient boiler replacement in the Town Hall. A large portion of this boiler is being paid for with an Energy Efficiency and Conservation Block Grant. The boiler will be installed July 2010.

In Siemens' initial scoping audit of the two elementary school buildings for the GMRSD, they projected energy savings of 16% at Hillcrest and 17% at Sheffield. Siemens is projecting an overall energy savings of about 16% in Montague's municipal buildings. The following table depicts Siemen's recommended Phase I.

Building	Energy Conservation Measure	Total Cost	Rebates	Energy Savings est	Payback (Years)
Town Hall	Lighting and Lighting Controls	$ 44,670	$ 8,046	$ 2,917	12.6
	Building Envelope	$ 30,615		$ 2,134	14.3
	Boiler Replacement	$ 173,172		$ 3,067	56.5
DPW Garage	Lighting and Lighting Controls				
	Building Envelope				
Unity Park Fieldhouse	Lighting and Lighting Controls	$ 3,943	$ 706	$ 407	8.0
	Building Envelope	$ 27,155		$ 1,548	17.5
Montague Center Library	Lighting and Lighting Controls	$ 7,075	$ 1,281	$ 207	28.0
	Building Envelope	$ 2,855		$ 402	7.1
Millers Falls Library	Lighting and Lighting Controls	$ 5,208	$ 938	$ 342	12.5
	Building Envelope	$ 3,790		$ 366	10.4
Carnegie Library	Lighting and Lighting Controls	$ 16,721	$ 3,013	$ 1,067	12.8
	Building Envelope	$ 931		$ 215	4.3
Water Pollution Facility	Lighting and Lighting Controls	$ 22,765	$ 4,120	$ 790	23.6
	Building Envelope	$ 12,079		$ 1,376	8.8

Potential Energy Conservation Measures (ECMs)

As a result of the preliminary site investigation, Siemens has identified the following potential Energy Conservation Measures (ECMs) at Montague municipal facilities. The following ECM Matrix summarizes the applicable ECMs that were identified for each facility during the preliminary investigation:

ECM#	Measure Description	Town Hall	Parks & Recreation	Highway Department	Carnegie Library	Montague Center Library	Millers Falls Library	Waste Water Treatment Plant
1	Lighting							
	T- 8 to Super T-8s	X	X	X		X		X
	T-12 to Super T-8s	X	X		X		X	
	T-5 HDs							
	Compact Fluorescent	X	X		X	X		X
	LED Exist Signs				X	X		
2	Lighting Controls							
	Occupancy Sensor			X				X
	Daylight Harvesting							
3	EMS Installation/ Optimization	X	X		X	X	X	X
4	Motors & Drives							
5	Stratification Fans							
6	Cooltrol Cooler Controls	X						
7	Furnace Replacement		X		X	X		
8	Replace Hot Water Heater							
9	Insulate Heating Lines					X	X	
10	Boiler Replacement	X					X	X
11	Steam Trap Replacement							
12	Steam to Water Conversion			x				
13	Install Infra-red Heaters			X				
14	Overhead Door Upgrades	X	X	X				
15	Weatherstripping			X	X		X	
16	Window Replacement	X	X	X	X		X	X
17	Building Envelope Improvements	X	X	X			X	

This matrix depicts many of the ECM's set forth in the goals of this plan.

4 SUMMARY OF FOSSIL FUEL REDUCTION MEASURES

Overview of Short and Long Term Goals

SHORT TERM GOAL: Meet a minimum of 20% reduction of fossil fuel usage by June 30, 2013

Objectives

- Finalize ESCO Phase I which will includes Town Hall Boiler Replacement
- Phase II to include : DPW boiler replacement, Water Pollution Facility improvements, elementary school improvements, library improvements
- Photovoltaic panels on Town Hall Roof
- Photovoltaic panels on Town Landfill
- Photovoltaic panels on Public Safety Complex

LONG TERM GOAL: Reduce fossil derived energy usage 80% by 2050

Objectives

- Rebuild a more efficient Highway Garage
- Continually seek out and investigate new technology that can reduce usage and emissions.
- Continue to offer and expand public education and awareness through the school system and special events
- Explore innovative projects such as deep energy retrofits
- Consider energy efficiency paramount in all new municipal construction projects
- Secure grant monies and plan for 100% renewable energy generation

GETTING TO 20%

The Town plans to get to 20% using a combination of recent and planned ECM's as well as supplementing our fossil fuel reduction with planned renewable energy generation projects. See the following table for a prioritized list of strategies to reduce fossil fuel usage, all slated to occur in the next 5 years.

Plan Summary

ENERGY CONSERVATION MEASURES	MMBTU	Baseline Reduction
FY 08 BASELINE	25115	
Existing ECM	(686)	2.5%
Planned ECMs 5 Years	(4089)	16.3%
ECM total	***(4775)***	***19%***
Renewable Offset	(2744)	10.9%
2013 TOTAL ENERGY REDUCTION	***(7519)***	***29.9%***

5 FOSSIL FUEL REDUCTION MEASURES

AShort Term Energy Efficiency Conservation Measures

	PLANNED ENERGY CONSERVATION MEASURES	STATUS	MMBTU Savings	Baseline Reduction
9 buildings	Performance Contract Phase I Town Hall Boiler, lighting and lighting controls and envelope improvements in 7 buildings*	Phase I Investment Grade Audit Complete. Retrofits begin 8/10	326	1.3%
Elementary schools	Sheffield School, Hillcrest School Performance Contract: EMS, Lighting, boiler replacement, HVAC improvements, bldg envelope	Phase II ESCO 6/11	1,972	7.9%
Safety Complex	Efficiency monitoring and HVAC Improvements. Demand Ventilation Control	Phase II ESCO 6/11	94	.4%
WPCF	Fine bubble aeration, dewatering septage, utilize Fournier Rotary Pass	Phase II ESCO 6/11	1,386	5.5%
Colle	Review Leasesto encourage energy savings in buildings leased by town	winter 2011	74	.3%
DPW Garage	Garage heating system improvements, new energy eff monitors, modification of operational controls	Phase II ESCO 6/11	222	.9%
Carnegie Library	Carnegie Library storm windows (historically appropriate)	Phase II ESCO 6/11	In planning stages	.1%
Fleet	Replace existing vehicle with Energy Efficient vehicle	one new vehicle expected in 5 yrs	15	0%

*figure does not yet include town hall boiler replacement

Description of Select Energy Conservation Measures

Lighting and Lighting Controls

Siemens proposes to replace/retrofit the existing T-12 and T-8 fluorescent fixtures with the new Sylvania Xtreme Super T-8 system. This system is one of the lowest wattage systems on the market today, utilizing the 28w T-8 lamp and the high efficiency super saver ballast. Siemens will also retrofit any incandescent lighting fixtures to compact fluorescent units, as well as replacing older technology exist signs with new LED equivalents.

A survey of the applicable facilities revealed that there are no lighting control devices, such as occupancy sensors which would automatically turn off the lights in areas that are unoccupied. The installation of occupancy sensors throughout the facilities would dramatically reduce electrical waste by automatically turning off lights when they are not needed. Dataloggers will be installed throughout a sampling of areas during the detailed audit, to clearly quantify the potential for savings.

Energy Management Systems

In order to reduce energy consumption and improve occupancy comfort, Siemens proposes to install new Direct Digital Controls. New controls will be included in the Town Hall, the Parks & Recreation, the Carnegie Library, the Montague Center Library, the Millers Falls Library, and the Waste water Treatment Plant.

The new systems shall be supplied with all the necessary software to perform the specified functions. Details and characteristics of system software shall be included as part of the technical proposal and shop drawing submittals. The following system software shall be supplied as a minimum:

- 365 day Zone Scheduling
- Optimum Start
- Historical Tracking Database
- Full Color Graphics
- Logical programming functions

Proposed Sequences of Operations

The following are some of the proposed control sequences which will be used to save energy and reduce operating costs.

Night Setback:

By implementing this EMS strategy, the energy required for heating or cooling during unoccupied hours is reduced by lowering the heating space temperature set point or raising the cooling space temperature set point. For example, the space temperature can be reduced from the normal winter inside design temperature (70°F -72°F) to a lower space temperature (55°F - 60°F) during the unoccupied periods.

Scheduled Start/Stop:

The scheduled start/stop program consists of starting and stopping equipment based on the time of day and day of week. Scheduled start/stop is the simplest of all EMS functions to implement. This program provides the best potential for energy conservation by turning off equipment or systems during unoccupied hours. The new system will also allow systems to be turned off during holidays.

Optimum Start/Stop control of HVAC System Equipment:

The scheduled start/stop program previously described is refined by automatically adjusting the equipment operating schedule in accordance with space temperatures and outside air temperature. In the scheduled start/stop program, HVAC systems are started prior to occupancy to cool down or heat up the space on a fixed schedule independent of outside air temperature and space conditions.

The optimum start/stop program automatically starts and stops the system on a sliding schedule. The program will adjust start/stop time by taking into account the thermal inertia of the structure, the capacity of the HVAC system to either increase or reduce space temperatures, outside air temperature conditions, and current space temperatures, using prediction techniques.

These techniques determine the latest time for starting HVAC equipment to satisfy the space environmental requirements at the beginning of the occupied cycle, and determine the earliest time for stopping equipment at the day's end.

Demand Ventilation Control

Heating and cooling energy will be saved if ventilation air (i.e. outside air) is reduced during the occupied period. The quantity of ventilation shall be based on maintaining a tracer gas, carbon dioxide (CO_2) as an indicator of indoor air quality. A limit of 1000 PPM of CO_2 is recommended in ASHRAE Standard 62-1982, *Ventilation for Acceptable Indoor Air Quality*. Sensors shall be installed to measure the building air CO_2 concentration. The sensors shall be inputs to an EMCS controller, whose output to the outside air damper will maintain the CO_2 setpoint. During unoccupied periods the outside air dampers shall be closed.

The new EMS will allow the facility to monitor the energy consuming equipment in the building remotely in real-time, track the facility energy performance, and remotely adjust setpoints and schedules to optimize the facility operation.

Heating System Upgrades

Forced Air Furnaces

The Carnegie Library and the Montague Center Library have small oil fired furnaces to heat the buildings. The highest efficiency available in a typical oil fired furnace is in the low 80% range. New oil fired condensing furnaces are available that can achieve efficiencies in the high 90% range. By replacing the oil fired furnaces with high efficiency, condensing, oil fired furnace energy consumption can be reduced.

The Parks & Recreation Building has a small propane furnace to heat the building. The highest efficiency available in propane furnace with an atmospheric burner is in the low 80% range. Gas fired condensing furnaces can achieve efficiencies in the high 90% range. By replacing the old furnace with a high efficiency, condensing, propane furnace, energy consumption can be reduced.

Boiler Replacement

Siemens proposes to replace the existing boilers in the Town Hall, Millers Falls Library, and the Waste Water Treatment Plant with new energy efficient boilers. Cast iron sectional oil boilers are not as efficient as new oil fired condensing boilers. Condensing boilers can achieve efficiencies as high a 95% where the existing boilers can be in the low as 80%.

Infra-red Heaters

Infra-red heaters are well suited for use in garages and warehouses. Infra-red is a more efficient method of heating as it heats the floor and the objects rather than the air. Siemens will replace the existing steam unit heaters in the Highway Garage with energy efficient infra-red heaters.

Insulate Heating Lines and Ducts

Bare heating pipes and hot air duct systems lose heat to the surrounding environment. The greater the temperature difference between the heating lines and the surrounding area, the greater the heat lost.

Siemens proposes to insulate the bare heating lines and valves at the Millers Falls Library, and the heating ducts in the basement crawl space of the Montague Center Library will be insulated as well.

Steam to Hot Water Conversion

Converting an existing steam system to hot water heat can offer significant energy savings. Hot water systems operate more efficiently by maintaining lower temperatures in the system. Where steam must be raised to at least 212°F to transfer heat throughout the building, hot water can be reduced to 100°F or lower.

Steam boilers are limited in their efficiency by virtue of their operating temperatures. They typically achieve efficiencies in the 70's or low 80% range. Hot water boilers can achieve efficiencies as high as 96%.

Siemens makes the recommendation to replace the existing steam system that serves the offices at the Highway Department with a high efficiency hot water system.

Building Envelope Improvements

Air leakage is defined as the "uncontrolled migration of conditioned air through the building envelope" caused by pressure differences due to wind, chimney (or stack) effect, and mechanical systems. Air leakage has been shown to represent the single largest source of heat loss or gain through the building envelopes of nearly all types of buildings. Beyond representing potential for energy savings, uncontrolled air leakage can affect the thermal comfort of occupants, air quality through ingress of contaminants from outside and the imbalance of mechanical systems. The structural integrity of the building envelope can also be compromised through moisture migration. Control of air leakage involves the sealing of gaps, cracks and holes, using appropriate materials and systems, to create, if possible, a continuous plane of "air-tightness" to completely encompass the building envelope. Part of this process also incorporates the need to "decouple" floor - to - floor, and to "compartmentalize" components of the building in order to equalize pressure differences.

Overhead Door Replacement

We recommend replacing the old and inefficient overhead doors with a new insulated overhead door at the Town Hall, Parks & Recreation, and the Highway Garage.

Waste Water Treatment Plant Improvement Measures

Continual increases in energy cost in the United States affect wastewater treatment plants(WWTPs) just as they do other facilities. Energy costs can account for 30 % of the total operation and maintenance (O&M) costs of WWTPs (Carns 2005), and WWTPs account for approximately 3% of the electric load in the United States. Furthermore, as populations grow and environmental requirements become more stringent, demand for electricity at such plants is expected to grow by approximately 20% over the next 15 years (Carns 2005).Energy conservation is thus an issue of increasing importance to WWTPs.

Siemens identified several preliminary energy conservation measures for the Montague Wastewater Treatment Plant. Actual feasibility and cost effectiveness will be evaluated during the detailed energy audit phase of this project.

Sludge Pump VFD

Sludge pumps are utilized to pump the sludge from the sludge tanks. These pumps operate at constant speed. A significant amount of electrical savings can be achieved by installing a variable frequency drive. The drive speed shall be varied based on sludge levels.

Anaerobic Digesters

Wastewater digester gas can serve as a natural gas fuel substitute in applications such as boilers, hot water heaters, reciprocating engines, turbines and fuel cells. The gas produced by anaerobic digestion is usually more than 60 percent methane, and some plants with state-of-the-art facilities have the potential of producing a biogas with concentrations of methane that reach up to 95 percent. This biogas is produced on a continuous basis, and contaminants, such as hydrogen sulfide, are removed prior to use. Other processing may include dehydration, filtering or carbon dioxide removal.

The most common use of wastewater treatment methane is for internal process heat used in the wastewater digesting process. This can be provided directly or by converting to steam in a boiler. The most popular technology to convert wastewater treatment gas to electricity employs internal-combustion engines that run a generator to produce electricity. This is most often used to power internal operations, with the excess being sold back to the grid. Heat generated by these engines can also be recovered and used to heat digesters and plant facilities, thus improving overall system efficiency. Another proven application employs microturbines which also produce electricity. These can be modularized and easily expanded as gas production expands.

UV Irradiation Systems

UV is a non-chemical disinfection technique. UV provides municipalities and industries with a cost-effective means of complying with today's strict environmental regulations. This provides a huge benefit for wastewater discharge and water reuse. UV improves end-product quality and protects the consumer from disease without the need to handle or store hazardous chemicals. The systems are compact and easily retrofitted and can be automatically controlled using existing process control software.

Highly efficient treatment can be obtained by using a programmable logic controller (PLC), ensuring the minimum UV intensity required for adequate disinfection is maintained for changes in flow rate and water quality. The UV dose the microorganisms receive is a factor of the lamp's UV intensity multiplied by the exposure time with a correctional factor for the absorption level of the fluid. The UV dose required for satisfactory disinfection is calculated according to the type of microorganisms in the liquid. UV is a photochemical process destroying unwanted microorganisms without changing the chemistry of the medium or altering the odor, flavor, or pH of the liquids.

Fine Bubble Aeration

The use of diffused aeration generally comes down to a choice of using coarse bubble versus fine bubble diffusers. Originally, most diffused air systems used fine bubbles created with porous type media such as ceramic plates. These systems were prone to plugging and fell out of favor over twenty years ago in lieu of coarse bubble diffusers. The coarse diffusers systems are less prone to plug because they push the air

mass out through large orifices. Their primary disadvantage is the loss of efficiency that is inherent in using large versus small bubbles.

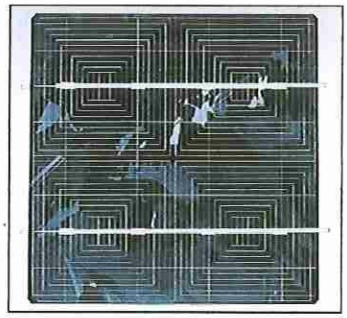
If a given volume of air is broken into large bubbles, while an equal amount of air is broken into small bubbles, the smaller bubbles will create a greater opportunity for oxygen to transfer into the water. This is because the smaller bubbles will contain the same volume of air in a greater number of air bubbles. As the number of bubbles increase, so does the available surface area over which air can be transferred into water. Fine bubbles are much more efficient at transferring air because they create a larger transfer surface area per unit volume of added air. While coarse bubble diffusion efficiency may have an OTE of 0.75% per foot of pond depth, fine bubble systems may have an OTE of up to 2% per foot. This means that twice as much air can be transferred from the same air volume using fine bubbles as could occur using coarse bubbles.

Compared to many older systems, fine bubble aeration can reduce the power required to transfer oxygen (and its associated costs) by up to 30%.

Solar Photovoltaic

A solar tracker is a device for orienting a solar photovoltaic panel or concentrating solar reflector or lens toward the sun. The sun's position in the sky varies both with the seasons (elevation) and time of day as the sun moves across the sky. Solar powered equipment works best when pointed at or near the sun, so a solar tracker can increase the effectiveness of such equipment over any fixed position, at the cost of additional system complexity. There are many types of solar trackers, of varying costs, sophistication, and performance.

Photovoltaics is the process of converting sunlight into electricity by means of a photovoltaic cell. The photovoltaic cell is a solid-state device composed of thin layers of semiconductor materials which produce an electric current when exposed to light. Single cells are connected in groups to form a module, and modules are grouped to form an array. The voltage and the current output from the array depend upon how the system is configured. Photovoltaic cells produce direct current (DC) electricity, the type of electricity contained in batteries. Most appliances, however, are designed to use alternating current (AC) electricity, the type available from a standard wall socket.

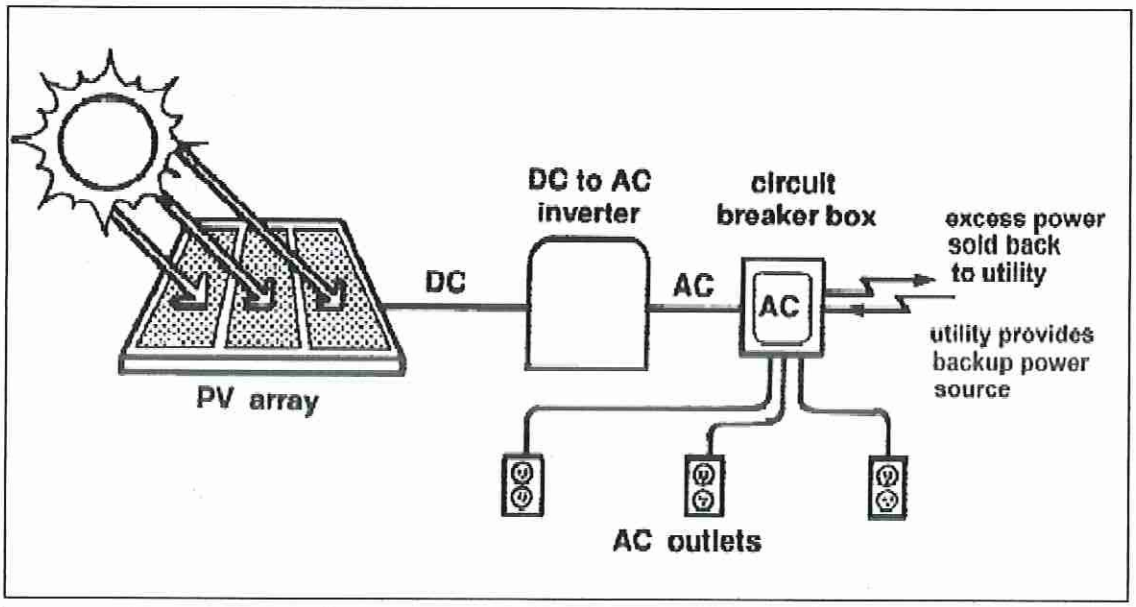


When AC current is required, an inverter is added to the photovoltaic system to change the current from DC to AC, but this will incur a 10-15 percent loss of power output. Photovoltaic-generated electricity has many applications.

The amount of area covered by photovoltaic panels will generate approximately 75,000 watts of electric power at full output. Several factors tend to limit the generation, however, these including the slope of the surface with respect to horizontal, occasional snow cover, and bird excrement. These factors are not expected to decrease the system performance to any great extent, however.

The new panels will be installed directly on the existing roof. Siemens assumes that their weight is not so great as to warrant greater structural support than currently exists, and this will be confirmed during the detailed audit.

The energy generated by the photovoltaic modules will be tied directly into the facility's power and to the grid. This "Clean Green Energy" output is at its highest level when the sun's intensity is peaking. This new energy will coincide with the facility's need for space cooling and expensive summer electricity demand.



The system is environmentally attractive. Although this measure usually has a high pay back, further financial incentives are anticipated to be available to help defray the initial cost.

5 CONCLUSION

Using the strategies identified in this plan, the Town of Montague will achieve a 20% reduction in municipal energy use by 2013. With an eye toward sustainability, the Town recognizes that this plan will dually ease municipal budgets in the long term and establish Montague as an energy efficient community. The Town, in conjunction with the Montague Energy Committee is responsible to see this plan come to fruition via yearly energy usage tracking and project planning. The funding for these improvements will derive from innovative grants, performance contracting, and capital improvements.

Resources and Contacts

Town of Montague
http://www.montague.net/
Pioneer Valley Clean Energy Plan
http://www.frcog.org/pubs/landuse/Clean_Energy_Plan/PVPC-CLEAN_ENERGY_PLAN_final.pdf
Siemens Building Technologies, Inc.
http://www.buildingtechnologies.siemens.com/bt/us/Home/Pages/BUILDING-AUTOMATION-industry.aspx
Franklin Regional Council of Governments
www.*frcog*.org
Western Mass Electric Company
http://www.wmeco.com/
Berkshire Gas Company
http://www.berkshiregas.com/
Sandri New England Energy Solutions
http://www.sandri.com/
Mass Energy Insight Energy Tracking Program
http://www.massenergyinsight.net/
Green Communities Program
http://www.mass.gov/?pageID=eoeeasubtopic&L=3&L0=Home&L1=Energy%2c+Utilities+%26+Clean+Technologies&L2=Green+Communities&sid=Eoeea