City of Worcester, Massachusetts

Climate Action Plan

December 2006

Energy Task Force

CLEAN AND GREEN

Regional Environmental Council

Vision Statement

The City of Worcester seeks to be a leader in sustainability. To improve the city's economic viability and quality of life, we are pursuing the efficient and wise use of natural resources and clean, sustainable sources of energy to serve our needs for mobility, housing, education, community building, economic growth, public safety, and other necessities.

The goal of the Climate Action Plan is to reduce Worcester's energy use and greenhouse gas emissions through a combination of cost-recoverable and cost neutral action. This action will put Worcester on a course towards a sustainable future and improve the quality of life for Worcester's residents, visitors, workers, businesses and institutions. It is our hope and intention that this Climate Action Plan will inspire responsible resource and energy consumption throughout the greater state, national, and global communities.

Acknowledgments

The Climate Action Plan was prepared by Energy Consultant Carissa Williams, consultant to the Regional Environmental Council and Coordinator of the City of Worcester's Energy Task Force. Task Force members provided direction, data, decision making, and review of this document.

Between February 2006, when the Energy Task Force was appointed, and September 2006, fourteen meetings where held by the task force and the three sub-committees of Transportation, Energy Efficiency, and Renewable Energy. During these meetings, ideas were exchanged, questions asked, differing points of view brought forward, and decisions made that led to the development of this document.

The City of Worcester's Energy Task Force consists of the following appointed members:

Brian Blood	NSTAR
John Carney	Worcester Regional Transport Authority
Larry Chretien	Mass Energy Consumers Alliance
Bob Fiore	Assistant to the Commissioner of DPW, City of Worcester
Rob Krueger	Worcester Polytechnic Institute
Jeff Lassey	Director of Facilities, Worcester Public Schools
Peggy Middaugh	Regional Environmental Council
Gene Olearczyk	Worcester Public Schools
John Orrell	Purchasing Director, City of Worcester
Adam Parker	Conservation Services Group
John Rugg	DPW Fleet Manager, City of Worcester
Peter Russo	National Grid
Eric Twickler	Principal Architect, City of Worcester
Stephen Willand	(ETF Chair) Director of the Division of Workforce Development, City of Worcester
Joseph Zwirblia	Worcester Regional Airport Commission

Special thanks to the following individuals whose input, resources and recommendations were invaluable to the development of the Plan:

Phil Brodeur	Worcester Regional Airport
Jim Christo	Massachusetts Technology Collaborative
Ben Farmer	Alternative Energy Store
Phil Guerin	Environmental Services, City of Worcester
Bob Hoyt	Director of Water Filtration, City of Worcester
Tyler Leeds	Massachusetts Technology Collaborative
Kim Lundgren	ICLEI - Local Governments for Sustainability
Nicholas Marchese Jr.	Senior Clerk Typist
Steve Russell	Fleet Manager, City of Keene, NH
Casey Steele	Mass Energy Consumers Alliance
Karin Valentine Goins	Active Citizen, City of Worcester
Tom Walsh	UBWPAD

Also a special thanks to the Mass Technology Collaborative whose Clean Energy Choice matching grant funds made this project possible.

From the City Manager

Climate change is upon us and its effects are already apparent throughout the world. The scope and magnitude of the potential changes to our environment present a clear danger to our way of life and continued economic development worldwide. Our reliance on fossil fuels has left a legacy of a fundamentally altered planet. Fortunately, the changes to our climate thus far have not yet affected our way of life. However, within a generation we may face changes that will cause great dislocation, strife and energy shortages as the world's economic development demands more from an oil exploration and production system that has already peaked.

It is within this context that we must decide how we, the City of Worcester, will contribute to addressing this challenge.

Reducing our greenhouse gas emissions is within our reach. We can reduce the pollution that causes global warming by using currently available technologies that also enhance economic development. In our schools, homes and places of work, we can implement energy efficiency measures, use renewable energy, and increase waste recycling to pollute less and save money. These measures are not in conflict with economic development; instead, they are the basis on which our future economic development and quality of life will rely.

Our actions can be an example to others, inspiring responsible energy and resource consumption. As cities around the world make similar commitments, we can collaborate with each other to reduce climate change, improve energy security and improve our economic competitiveness. We all must work together to become more sustainable. By taking part in this global effort we can succeed. Please join me in implementing this plan and achieving a more sustainable Worcester, and help us become "The GREEN heart of the Commonwealth"!

Michael V. O'Brien
City Manager

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Common Abbreviations & Acronyms in this Document

CACPS	Clean Air Climate Protection Sofware
CAP	Climate Action Plan
CCP	Cities for Climate Protection Campaign
CH_4	Methane
CMRPC	Central Massachusetts Regional Planning Commission
CO_2	Carbon Dioxide
eCO_2	Equivalent Carbon Dioxide
EIA	Energy Information Association
EM	Energy Manager
EPA	Environmental Protection Agency
ETF	Energy Task Force
GHG	Greenhouse Gas
GWP	Global Warming Potential
HEV	Hybrid-Electric Vehicle
ICLEI	ICLEI-Local Governments for Sustainability
IPPC	Intergovernmental Panel on Climate Change
KW	Kilowatt
kWh	Kilowatt hour
LEDs	Light Emitting Diodes
LEED	Leadership in Energy and Environmental Design
LORI	Large Onsite Renewables Initiative
MPG	Miles per gallon
MTC	Massachusetts Technology Collaborative
MWh	Megawatt hour
NO_x	Nitrogen oxides
PV	Photo-Voltaic
REC	Renewable Energy Certificate
RPS	Renewable Portfolio Standard
WRTA	Worcester Regional Transport Authority
VMT	Vehicle Miles Traveled
UBWPAD	Upper Blackstone Water Pollution Abatement District

Helpful Definitions in Reading this Document:

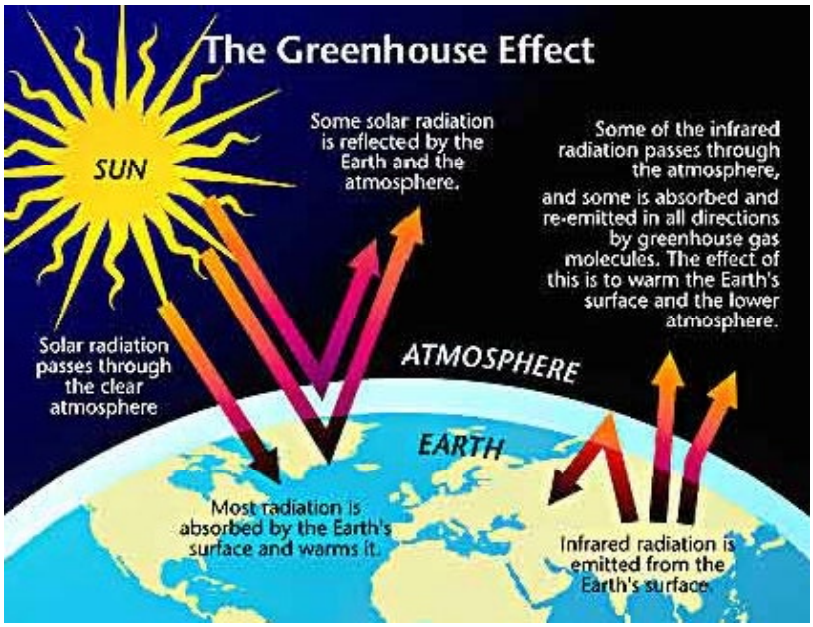
Anthropogenic	Caused or produced by humans.
Clean Energy Choice®	A program of the Massachusetts Technology Collaborative (MTC) that matches the premium paid by electricity consumers in MA for clean, renewable energy (should the consumer choose to participate) and creates a fund for cities that they may use for any project in support of clean energy.
Clean Energy Fund	The fund set up by the Clean Energy Choice program mentioned above. The fund is to be used exclusively for projects that support clean, renewable electricity.
Criteria Air Pollutants	Air pollutants that are harmful to human health and regulated by the EPA.
Energy and Environment Manager (EEM)	Job titled of the proposed full-time staff whose responsibilities would include overseeing the implementation of the Climate Action Plan, updating the GHG emissions inventory, and writing annual progress reports.
Global Warming Potential	Each greenhouse gas differs in its ability to trap heat. This ability is called global warming potential or GWP. Carbon dioxide has a GWP of one, and the GWP of all other gases is measured relative to CO_2.
eCO_2	Greenhouse gases are quantified in terms of eCO_2 (carbon dioxide equivalents). You can think of this as one molecule of gas A has the same heat trapping effect as 1*GWP_A molecules of CO_2. For instance, methane has a GWP of 21. If 10 molecules of methane are emitted, the emissions in eCO_2 are 10 * 21 = 210. Emitting 10 molecules of methane has the same effect on climate change as 210 molecules of CO_2.
KW vs kWh	Kilo-watt hours (kWh) are determined by the amount of kilo-watts (KW) multiplied by the amount of time generating electricity. Example: If a solar panel that produces 2KW is operating for 5 hours, 2KW * 5hrs = 10kWh, 10 kWh are generated.
Photovoltaics (PV)	Solar panels that produce electricity.
Renewable Portfolio Standard (RPS)	A state law that requires a certain percentage of electricity sold each year to be generated by clean, renewable sources.
Sustainable	To live in a way that ensures that our quality of life will not degrade and that future generations will enjoy the same or better quality of life.

Executive Summary

The threat of climate change impacts - increased temperatures, more extreme heat days, and changing precipitation patterns - are becoming more real each day.

While scientists can not predict exactly how climate change will affect each area of the globe, they can model the general impacts and hazards.

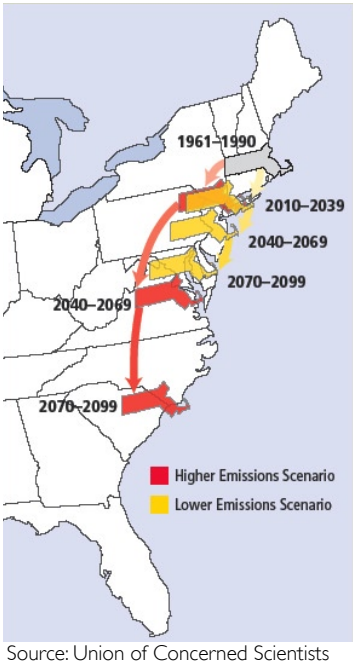
What is **not** disputed are the facts that 1) carbon dioxide (CO_2) concentrations in our atmosphere have been steadily increasing since pre-industrial times, 2) this increase in CO_2 is largely due to human influence, and 3) that an increase in CO_2 (aka greenhouse gases) in the atmosphere increases the average temperature. Many credible scientific agencies, such as the U.S. EPA, the IPCC, and NOAA, have stated these facts.



Source: NACC/USGCP graphic from Union of Concerned Scientists Website (http://www.ucsusa.org/globalwarming/index.html)

The City of Worcester has decided to take responsibility for its contribution to greenhouse gas emissions. In October 2003, the Mayor Timothy Murray proposed a resolution to City Council and Worcester became the 19th city in Massachusetts to join the Cities for Climate Protection (CCP) Campaign - a campaign run by ICLEI Local Governments for Sustainability. CCP is an international campaign of local governments who are committed to reducing their greenhouse gas emissions. CCP offers a five step process to help local governments achieve this commitment: 1) Conduct a Greenhouse Gas Emissions Inventory and Report for the entire community as well as municipal operations. 2) Set a Greenhouse Gas Emission Reduction Target. 3) Develop a Local Climate Action Plan. 4) Implement the Local Climate Action Plan. 5) Monitor Emission Reductions

Summers in Massachusetts
Summer in Massachusetts could feel like the typical summer in South Carolina by the end of the century unless we take action to reduce heat-trapping emissions today.



Source: Union of Concerned Scientists

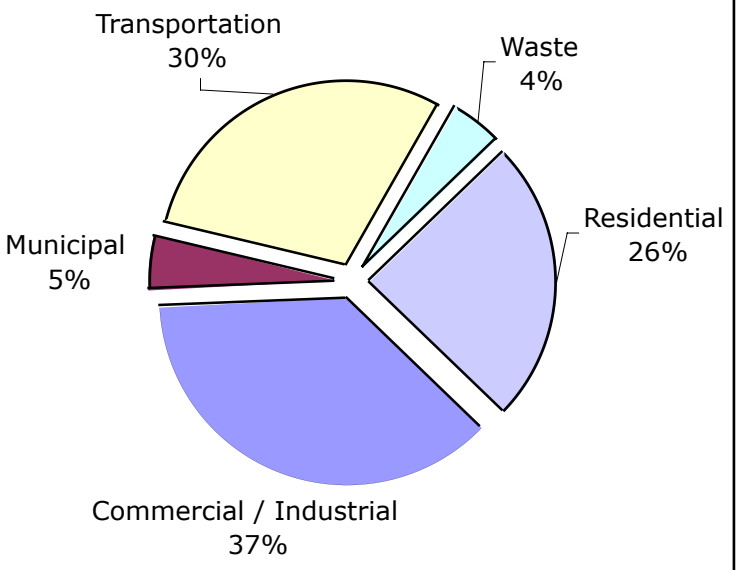
CCP has engaged over 770 communities worldwide, 25 of which are in Massachusetts. Many of these communi-

ties have completed Step 3 by putting together an Energy Task Force to advise on and write their Climate Action Plans. In February 2006, City Manager, Michael V. O'Brien appointed 14 representatives from City government, businesses, utilities, universities and the environmental community to Worcester's Energy Task Force (ETF) and contracted with the Regional Environmental Council to hire a part-time Energy Consultant to coordinate the group. The mission of the ETF was to create a step-by-step plan to reduce energy consumption, reduce greenhouse gas emissions and increase the use of clean, renewable energy in a cost-effective manner in the city of Worcester.

This Climate Action Plan helps Worcester complete CCP's Step 3, but its purpose reaches beyond CCP. First, it also helps Worcester to be less wasteful in its energy use, thus saving money and making better use

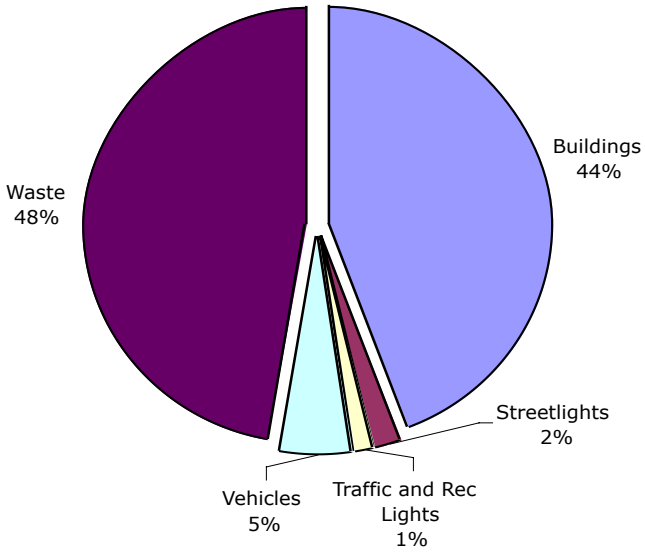
Community GHG Emissions by Sector

The majority of emissions are produced from transportation, housholds, and businesses, with municipal emissions making up a smaller, but meaningful, portion.



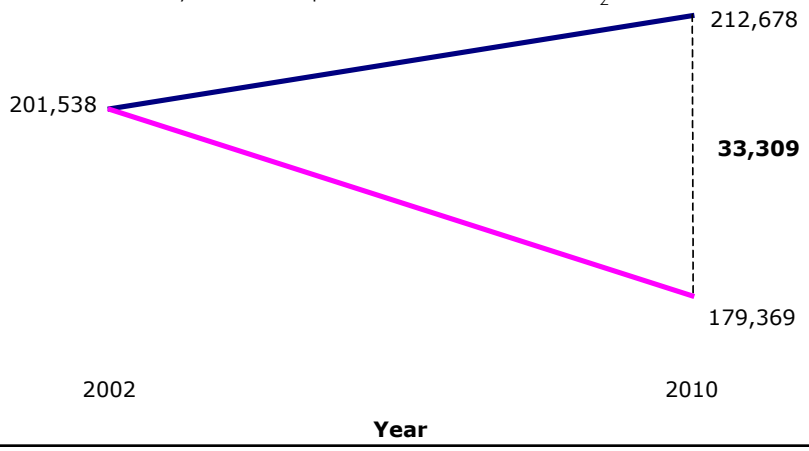
Municipal GHG Emissions by Sector

The vast majority of municipal greenhouse gas emissions come from energy consumed by buildings and waste generation, while vehicle emissions also play a large role.



Business as Usual vs. 11% Reduction Target

Worcester would need to reduce the forecasted "Business as Usual" 2010 emissions by 15.7% to meet a target of an 11% reduction of 2002 emission levels by 2010. Reported in tons of eCO_2.



of taxpayers' dollars. Second, the plan helps to attain the 20% renewable electricity goal adopted by the City Council in March 2005 and support the generation of clean, renewable sources of energy, thus contributing to a more reliable, safe, and secure energy supply.

CCP Step 1, Worcester's greenhouse gas emissions inventory, was originally completed in April 2004 by Carissa Williams, Worcester's Energy Consultant, as part of her master's degree work at Clark University. The purpose is to show where greenhouse gas emissions originate and thus where reduction may be made.

A municipal reduction target, the second step of CCP, of **11% below 2002 GHG emission levels by 2010** is being proposed along with submission of the Climate Action Plan to the Worcester City Council. Within this plan, the Energy Task Force proposes various actions that the City may take to reduce their greenhouse gas emissions. These measures range from increasing energy and fuel efficiency to using renewable energy sources and reducing waste. Implementation of all measures in this plan would lead to a municipal GHG reduction of approximately 43%, well over the 11% 2010 target. The majority of these emission reductions would result from reducing waste at schools, increasing residential curbside recycling, and capturing methane from the Greenwood Street landfill. Capturing methane from the landfill and turning it into energy also has the potential to produce almost 45% of the entire municipal electricity needs (including the UBWPAD sewage treatment plant) as a clean, renewable resource.

CPP Steps 4 and 5 involve implementing and monitoring the actions proposed in this plan. To effectively accomplish this, the Energy Task Force should evolve into an advisory committee and include more members from the local business community as well as more university and residential representatives. As the Energy Consultant's grant-funded position will be ending this month, the City should hire a full-time Energy Manager (EEM) who, with the help of the ETF, would be responsible for overseeing plan implementation, helping to find sources of funding, creating new reduction targets, and enlisting citizen support. The Energy Manager could also complete an annual GHG emissions inventory to monitor energy use and the effects of emission reduction actions, as well as author an annual progress report on the status of measures that have been implemented and measures planned for the next year.

The effort to stabilize man-made greenhouse gases in the atmosphere will require a long-term commitment. The emission reduction goals that are currently being set on local, national and international levels are the starting point for an unprecedented global effort to lessen the potentially devastating impacts of an environmental problem that can affect every person on this planet. The City of Worcester has begun to take steps to protect itself and its citizens from climate change and rising energy prices by passing the Cities for Climate Protection Resolution, creating an Energy Task Force, and, most recently, becoming a member of ICLEI. The most important next steps for Worcester include hiring a full time Energy Manager, implementing cost-effective emission reduction measures, and creating a modern GHG emissions database. Creative ideas and solutions are always welcome.

Summary of Key Proposed Reduction Measures

Measure	Estimated Implementation Cost	Est. tons eCO_2 Reduced Annually	Est. Annual $ Savings	Payback Period	Estimated Fuel Saved/yr	Page #
Energy Efficiency						
Upgrade 200 Exit Signs From Incandescent Lights to LEDs	$3,000	23	$7,972	< 5 months	61,320 kWh	52
Co-Benefits: Reduces 243 lbs/yr of criteria air pollutants. Longer life of LEDs reduces maintenance costs.						
Upgrade to More Efficient Lights in the Pearl/Elm Garage	$44,280	89	$31,387	1.4 years	241,440 kWh	54
Co-Benefits: Reduces 957 lbs/yr of criteria air pollutants. Longer life of fluorescents reduces maintenance costs. Better light quality.						
Change-A-Light Campaign	$190,527 ($3/household)	2,424	$1,042,376 ($16.41/home)	.2 years	6,541,427 kWh	55
Co-Benefits: Reduces 25,925 lbs.yr of criteria air pollutants. Educates the community on energy use and shows the City's dedication.						
Renewable Energy						
Promote Clean Energy Choice	To be determined	16,455	$324,124	Unknown	44,400,605 kWh	63
Co-Benefits: Provides funding for municipal clean energy projects. Reduces criteria air pollutants by 175,971 lbs/yr. Educates the community on renewable energy and the City's dedication to the future of its residents.						
Purchase RECs	$25,000	309	0	0 (Immediate)	833MWh offset	67
Co-Benefits: City recovers all cost from MTC. Reduces 3,301 lbs.yr of criteria air pollutants. Helps reach 20% by 2010 goal.						
Install Hydro Power at the Water Filtration Plant	$300,000	292	$63,072	4.8 years	788,400 kWh	70
Co-Benefits: Reduces 3,125 lbs.yr of criteria air pollutants. Helps reach the municipal goal of 20% by 2010. Reduces electrical demand.						
Solar Heat at Schools	$2,788	1	$341	8.2 years	217 therms	72
Co-Benefits: Reduces 5 lbs./lyr of criteria air pollutants.						
Solar Hot Water at the Water Filtration Plant	$24,000	7	$1,456	16.5 years	18,194 kWh	74
Co-Benefits: Reduces 72 lbs.yr of criteria air pollutants. Helps to reach the municipal goal of 20% renewable electricity by 2010.						
Install a Wind Turbine at Crow Hill (site of the new North High)	$1,000,000 ($500,000 w/funding)	148	$52,000	19.2 years (9.6 w/funding)	400,000 kWh	75
Co-Benefits: Reduces 1,584 lbs.yr of criteria air pollutants. Helps to reach the municipal goal of 20% renewable electricity by 2010. Provides an educational resource for students and the community. Potential partnership with the Ecotarium.						
Solar Power at Vocational School	$8,000	1	$390	20.5	3,000 kWh	77

Summary of Key Proposed Reduction Measures (cont'd)

Measure	Estimated Implementation Cost	Est. tons eCO_2 Reduced Annually	Est. Annual $ Savings	Payback Period	Estimated Fuel Saved/yr	Page #
Vehicle Fleet and Transportation						
Enable 5-minute Shut-off in Trucks	$0	671	$130,150	0 (Immediate)	63,180 gallons	83
Co-Benefits: Reduction of 16,748 lbs/yr of criteria air pollutants. Less headaches and health problems for vehicle operators.						
Increase Fuel Efficiency of Gasoline Vehicle Fleet	Variable	224	$36,738	Unknown	21,739 gallons	85
Co-Benefits:						
B-20 Pilot at Hope Cemetery	To be determined	4	-$1,218	NA	1,965 gallons	90
Co-Benefits: Cost may be less from a different supplier or with credits applied. Less headaches and health problems for vehicle operators.						
Increase Employee Carpooling	To be determined	4.742	$1,063,920 (for employees)	NA	443,471 gallons	94
Co-Benefits: Reduction of 1,375,158 lb/yr of criteria air pollutants, including a large reduction in ground level ozone creating pollutants. Lower percentage of employee paycheck being spent on traveling to work. Opportunity to lead by example for other businesses in Worcester.						
Waste						
Encourage Recycling at Apartment Complexes	To be determined	12,048	Unknown	Unknown	3,393 tons trash	103
Co-Benefits: Prevents emissions from incineration. Reduces energy needed for new products. Educates the community on waste and energy.						
Increase Residential Recycling Rate	To be determined	30,407	$312,776	Unknown	8,565 tons trash	106
Co-Benefits: Prevents emissions from incineration. Reduces energy needed for new products. Educates the community on waste and energy.						
Implement Recycling at Schools	To be determined	14,813	$152,376	Unknown	4,172 tons trash	107
Co-Benefits: Provides an opportunity to teach students about the importance of recycling and sustainable living.						
Energy Manager						
Hire a Full-time Energy Manager	**$70,000****	**346,989***	**$1,111,564***	**Unknown**	**NA**	**46**
Co-Benefits: Provides the opportunity to designate the City as a leader on issues of the environment, energy and sustainibility.						

* Represents the potential municipal cost and pollution savings of the proposed reduction measures that the Energy Manager would assume responsibility for. **Includes benefits.

Proposed Next Steps for Key Measures

1. Hire a full-time Energy Manager

A full-time Energy Manager is needed to continue as the guiding force of the Climate Action Plan. This individual would be responsible for overseeing the implementation of the Plan, ensuring that proper plans are developed before implementing reduction measures, updating the emissions inventory, and writing progress reports. The Energy Manager would serve as a unifying entity among the fragmented municipal departments regarding energy use, planning, budgeting, supply, and load aggregation and would serve as a gatekeeper for all municipal energy use data.
Want more info? See page 46.

2. Install a 100KW Hydro-Power Turbine at the Water Filtration Plant

The water filtration plant has a rare opportunity to be a highly productive renewable electricity generation source because of the nearly constant flow of water. Installing hydro-power could produce a significant amount of the electricity consumed by the water treatment facility.

Next Steps:

- Bring in a small hydro-power professional to do a site and cost assessment.
- Determine the amount of money the City has available for this project and if further funding sources are needed.
- Communicate with MTC on how to proceed to ensure funding.

Want more info? See page 70.

3. Develop a Plan for Installing a 250KW Wind Turbine at the New North High

The majority of renewable electricity produced in the U.S. comes from wind power. Installing a turbine in Worcester benefits the City by reducing GHG emissions, helping to meet the clean electricity goal, saving money on electricity costs, providing an educational tool, and providing a publicity tool for demonstrating leadership in energy.

Next Steps:

- Allow city employees and residents to make suggestions on potential wind sites.
- Suggestions can be reviewed by the Energy Manager and ETF and she/he can create a list of potential sites to be assessed along with a document with all of the suggestions and the pros/cons of each.
- Develop and adopt appropriate zoning ordinance to regulate wind power.
- Develop a partnership with the EcoTarium.
- Bring in a wind installer to assess the Crow Hill site and (maybe) other potential sites.
- Determine the amount of municipal money available to implement a wind installation.
- Contact MTC to determine best way to proceed.

Want more info? See page 75.

4. Enable 5-Minute Shut-Off in Municipal Trucks

Medium to heavy duty trucks in the City's vehicle fleet have the ability to be programmed to turn-off after a period of idling. A diesel vehicle idling for one hour each day wastes 500 gallons of fuel and is equivalent in engine wear to driving an additional 64,000 miles.

Next Steps:

- Put a plan in place for enabling the shut-off, determining who will be responsible and by when the switch should be complete.
- Do It!
- Be sure to enable shut-off on all new vehicles.

Want more info? See page 83.

5. Municipal Anti-Idling Policy

It is a Massachusetts law that no vehicle (unless under certain circumstances) can idle for longer than five minutes. The City should pass a supporting policy and bring awareness of this law and the harmful effects of idling to Worcester's residents.

Next Steps:

- Collaborate with WPS to identify key pickup areas and determine how many signs are needed.
- Estimate cost of printing and installation.
- Apply for grant funding if needed.
- Reduce idling - print signs, install and educate!

Want more info? See page 84.

6. Post Anti-Idling Signs at Schools

Schools are some of the worst places for vehicle exhaust. Parents who pick-up students often idle for 10-15 minutes. The City can cost-effectively post anti-idling signs to remind people that running their cars is polluting their children's air, not to mention wasting their gas and money.

Want more info? See page 84.

7. Potential Electricity Generation from Methane at Greenwood Street Landfill

Capturing the methane from the Greenwood Street Landfill and burning it to produce electricity has the potential to produce 45% of the municipal electricity needs from a clean, renewable resource and to reduce municipal GHG emissions by 30%.

Next Steps:

- Continue to monitor test well.
- Install more test wells.
- Contact the proper companies for site assessments and cost estimates.
- Conduct neighborhood meetings for input.

Want more info? See page 81.

8. Promote Clean Energy Choice®

Clean Energy Choice® is a program sponsored by the Massachusetts Technology Collaborative. Residents of Worcester participate by paying a small additional fee on their electric bills for renewable electricity. Their premium is matched by MTC is put into a Clean Energy Fund for the City to be used for renewable energy projects.

Next Steps:

- Create a goal for the number of sign ups.
- Create partnerships.
- Determine a plan for outreach.
- Issue a challenge to City employees.
- Secure outreach funding if needed.

Want more info? See page 63.

9. Create a Clean Energy Choice® Competition Between Schools

Reaching out to students is one of the most effective tactics for disseminating information. Not only are you teaching children at a young age, they often in turn relay that information to parents. The City and School Department should organize a Clean Energy Choice® competition within Worcester Public Schools to encourage increased participation. The school with the highest percentage of forms (or maybe a certain number by a certain date) returned and successfully processed would win an award and prize. This also could be incorporated into the science curriculum on renewable energy.

Want more info? See page 116.

10. Renewable Energy and Energy Efficiency Curriculum Development

It is important to educate students about energy issues. The Massachusetts Technology Collaborative offers a guide to incorporating lessons plans about energy resources and climate change into the MA science curriculum frameworks. They offer free curriculum materials on their website www.masstech.org/cleanenergy/curriculum/about.htm. There are also many locally held professional development workshops on the topic of teaching about energy.

Want more info? See page 116.

11. Create an Energy Theme for the Annual School Projects Fair

Every May WPS hold a joint Projects Fair. The Energy Task Force proposes that the theme of the 2007 fair be renewable energy and energy efficiency.

Want more info? See page117 .

12. Purchase $25,000 Worth of Renewable Energy Certificates (RECs)

The City has passed a resolution to purchase or produce 20% of the electricity used for municipal buildings and lighting from clean, renewable sources by 2010. One risk-free way of helping to meet this goal is by purchasing what are called Renewable Energy Certificates (RECs). The purchase of RECs will also be matched by MTC and put into Worcester's Clean Energy Fund.

Next Steps:

- Set a Clean Energy Budget of at least $25,000 / year
- Work with MTC to expand the $20,000 match to $25,000
- Set up an agreement with Mass Energy
- Publicize this action to help market Worcester as the "Green heart of the Commonwealth"

Want more info? See page 67.

13. Upgrade 200 Exit Signs from Incandescent Lights to LEDs

LED lighting is vastly more efficient than the traditional incandescent lighting, saving energy, time, money, and preventing GHG emissions. This action will pay for itself within months.

Next Steps:

- Determine the number of municipal exit signs and current lighting type of each sign.
- Work with NGrid to retrofit all incandescent signs and to determine the cost effectiveness of upgrading other types of exit sign lights (i.e. fluorescents).
- Implement a policy to ensure that future municipal exit signs are the most efficient lighting available

Want more info? See page 52.

14. Increase the Efficiency of Lighting in the Pearl/Elm Garage

Parking garages have high lighting and energy requirements because of the amount of time and space that it needs to be lit. Increase the efficiency of the lights can save money, electricity, and prevent GHG emissions. Additionally,

National Grid offers a rebate for upgrading parking garage lighting.

Next Steps:

- Have NGrid conduct an energy audit and efficiency assessment of the Pearl/Elm Garage.
- Implement NGrid's lighting energy efficiency recommendations.

Want more info? See page 54.

15. Implement a Change-A-Light Campaign: Encourage Residents to use CFL Bulbs

If every household in Worcester changed one bulb, it would amount to an energy savings of 6.54 mega-watt hours and a cost savings of over 1 million dollars annually. Other cities have implemented similar campaign, and Worcester has a good opportunity to partner with local resellers, Spags/Building 19 and Bulbs.com, to promote this action.

Next Steps:

- Determine the time line, goals, and partners in the Change-A-Light educational campaign.
- Seek out necessary funding.
- Implement the campaign and save energy.

Want more info? See page 55.

16. Develop an Energy Management System Using Energy Star's Portfolio Manager

An Energy Management System is important to the tracking of individual building's energy use, audits, and upgrades. Knowing the energy profile of individual buildings can save the City money and energy, and can essentially pay for itself after one to two years.

Next Steps:

- Input buildings data into Energy Star's Portfolio Manager online.
- Work with National Grid to set up Energy Audits and to document upgrade recommendations.
- Prioritize upgrades based on capital costs, cost savings, and energy/resource savings.
- Implement upgrades, documenting completed actions, and continue to track buildings energy and water consumption as well as energy audits and upgrade history.

Want more info? See page 49.

17. Pass a Municipal Energy Efficiency Purchasing Policy

A municipal Energy Efficiency Purchasing Policy means that when new appliances, lighting, and temperature control systems are purchased, their energy use and life-cycle costs are taken into account. This will ensure that new items have the greatest energy efficiency for their intended use, which will save the City money and reduce emissions.

Want more info? See page 58.

18. Pass a Municipal Green Building Policy

Green building means building in a way that reduces energy use, water consumption, sprawl, and indoor air pollutants. A municipal Green Building Policy means that the all new municipal buildings and major renovations would be required to meet LEED Silver standards unless the DPW & P, Architectural Services Division first makes a finding such certification is inappropriate. A draft Green Building Policy, based on the City of Arlington's policy, can be found in Appendix A.

Want more info? See page 59.

19. 2KW of Solar Electricity Panels at the New Vocational School

Solar electric panels (aka PV), while not the most cost effective technology, can provide a wonderful educational opportunity for residents and students. This is particularly important for a vocational school where students are

being trained in up and coming technologies.

Next Steps:

- Determine the amount of money the City has available.
- Bring in a solar expert for a site, power and cost assessment.
- Contract with solar installer and determine from whom to purchase the solar panels.
- Ensure solar panels will be electronically monitored for production.
- Apply for MTC funding.

Want more info? See page 77.

20. Look Into Solar Heating, Hot Water, and Electricity at Schools and Other Buildings

Solar technologies, such as air and water heating, can save the City energy, money, and reduce GHG emissions. They are often easy to install and maintain and can be used as an educational tool as well.

Next Steps:

- Bring in a solar expert to assess several predetermined Worcester public schools for solar heating, water, and electric feasibility.
- Other municipal buildings may also be considered for solar heating, hot water, and/or electricity, including the ***water filtration plant, the airport, and UBWPAD.***
- Determine amount of money available or an acceptable payback period.
- Seek out funding sources if needed.
- In new construction, assess the use of active and passive solar heating in the design stage.

Want more info? See pages 72-74, 79.

21. Biodiesel (B-20) Pilot Program at Hope Cemetery

The use and production of biodiesel has been increasing exponentially over the past 5 years and the growth is anticipated to continue. Many local governments in New England and throughout the country have begun to use biodiesel in their diesel vehicles. Biodiesel is made from vegetable oil and reduces pollution and GHG emissions.

Next Steps:

- Educate Hope Cemetery fleet director on the proper process of switching to B-20.
- Determine if a separate RFP is needed to purchase B-20 in the short term.
- Include B-20 specifications in the next RFP for vehicle fuel.
- Look into aggregating demand with other local communities.

Want more info? See page 90.

22. Increase Fuel Efficiency of Vehicle Fleet by Purchasing Vehicles w/ a higher MPG Rating

Often times inefficient vehicles are purchased for the municipal fleet when there is no need. A Fuel Efficient Vehicle Policy should be developed and passed stating that the most fuel efficient vehicle will be purchased in the class required to perform the needed tasks.

Next Steps:

- Pass a Fuel-Efficient Vehicle Purchasing Policy. (See Appendix A for a sample policy)
- Purchase and install a modern vehicle fleet software that can properly track mileage and fuel use.
- Develop a method for determining life cycle costs of new vehicles, and determine the increase in initial cost (if any) the City is willing to pay for more efficient vehicles.

Want more info? See pages 85-89.

23. Increase Employee Carpooling

Transportation accounts for about a third of GHG emissions in Worcester and in the state. Driving to work contributes significantly to this, and the City should be encouraging municipal employees to carpool, telecommute, take public transportation, bike, or walk to work.

Next Steps:

- Create an electronic survey for employees to fill out about their daily commute (samples can be found at MA DEP, ICLEI, and BWC). This will help to determine where reductions attempts should be made and to measure the results of education in changing commuter patterns.
- Create an online carpool message board for city employees so that workers coming from the same areas may easily link up.
- City Manager should send out an email to employees requesting that they complete the survey, announcing the creation of the carpool e-board, and encouraging employees to carpool - highlighting the benefits.

Want more info? See page 94.

24. Offer Employee Telecommuting

Next Steps:

- The feasibility of telecommuting will have to be determined by individual department heads.
- If it is feasible, they will have to decide on the number of telecommuting days that are appropriate.
- Once these two steps are completed, employees must be educated about this option (aka benefit).

Want more info? See page 96.

25. Increase Employee Commuters Traveling by Public Transport/Biking/Walking

Next Steps:

- Determine feasibility of various incentives.
- Create partnerships with WRTA and MBTA.
- Educate employees.
- Report on successes, obstacles, and solutions.

Want more info? See page 97.

26. Promote an Employee Take Public Transportation, Bike, or Walk to Work Week

Once a year some City officials take part in an Elected Officials take public transportation to work day. The City should expand on this idea to promote a week of taking public transportation, biking, or walking to work. Incentives could be offered by department heads for City employees, and the City could also issue a challenge to all businesses and employees who work in Worcester.

Want more info? See page 118.

27. Recycle at Schools

Implementing a recycling program in schools can save the City hundreds of thousands of dollars each year by reducing waste disposal fees. This would also significantly reduce GHG emissions and could serve as an example to other communities. Additionally, recycling in schools would teach Worcester's youth about recycling, making them more likely to recycle at home.

Next Steps:

- Determine equipment and resources needed to implement a recycling program.
- Decide which products will be recycled.
- Draft an implementation plan.

- Create a plan to get students excited.
- Begin recycling and record the amount of recyclables and trash.

Want more info? See page 107.

28. Increase Residential Recycling Rate from 27 Percent to 50 Percent

Since Worcester began its curb-side recycling program in 1994, recycling rates have decreased from 36.5% of waste in 1994 to 26.6% of waste in 2005. The City has a lot to gain by encouraging residents to recycle, such as reducing a significant amount of GHG emissions and saving a substantial amount of money.

Next Steps:

- Educate residents on how to make it easy to recycle (i.e. put a small bin for recyclables next to every trash bin in the house).
- Recycle at schools.

Want more info? See page 106.

29. Municipal Office Recycling Pilot at 44 Front Street

Some municipal offices are in privately owned buildings, such as the Planning, Department, Grants Acquisition, and Workforce Development, which are all at 44 Front Street. There is no recycling in this building, so building occupants must either throw everything in the trash and recycle it themselves. The City should set up a pilot recycling program at 44 Front Street for the municipal offices there. This will serve as an example and case study for other businesses in Worcester that are in a similar situation.

Want more info? See page 108.

30. Install Recycle Bins at City Hall and Downtown

To show the City's commitment to recycling, recycling containers should be installed next to trash cans inside of City Hall and in the outdoor downtown area. This will show people walking through downtown that Worcester cares about protecting the environment where they live and work. It may also motivate people to recycle in their own homes, knowing that their local government is putting in the effort to do so.

Want more info? See page 108.

31. Ensure that Recycling Containers are Visible at Every Municipal Event

Similar to placing recycling containers in City Hall and downtown, is the idea of providing the opportunity for people to recycle at City-sponsored events. This provides a leadership example for residents and lets them know that their city places importance on recycling. In 2005, the City received a DEP grant that provided event-type recycling containers that have been used at City-sponsored events at various parks. It is important to have these recycling containers visible at every City event without exception.

Want more info? See page 108.

32. Enhance the Municipal Buy Recycled Policy

The City currently has a "Buy Recycled" policy that goes out with all of its RFPs. This policy states that preference should be given to products containing recycled materials provided that the cost does not exceed 10% more than the cost of the same "new" product. However, Purchasing Director John Orrell states that he "can think of no bidder that has ever taken advantage of it". The City should enhance this current policy to make it more prominent, perhaps requiring the proposal of products that use recycled materials and those that do not, particularly with products like paper. Having a strong "buy recycled" policy supports the demand for recycling.

Want more info? See page 108.

33. Protect Open Space, Support Community Gardens, and Plant More Trees

Increasing the "green" in a City has many benefits: 1) Trees help to shade buildings and block winds, thus reducing the need for heating and cooling; 2) Vegetation filters air of harmful pollutants and takes up CO_2; 3) Greenery helps to mitigate the Urban Heat Island effect; and 4) Studies have shown that green environments help kids concentrate, increase girls' confidence, reduce violence and crime, and increase neighborliness.

Want more info? See pages 109-114.

34. Maintain Energy and Climate Information on the City Website

Having clear information online is vital. The City's website is its face to the world, and information should be kept up to date and useful. In September 2006, Energy Task Force web pages were posted to the City's website containing information about climate change, the mission of the ETF, and how residents can be a part of the solution. As GHG reduction measures are implemented, these actions should be publicized on these web pages.

Want more info? See page 115.

35. Hold an Energy Fair

This should be a highly informative and fun event that includes many community partners, vendors, and representatives. The main focus of the event should be to engage the entire community in learning about the City's GHG emission reduction initiative and ways for individuals and businesses to take an active role in helping to meet Worcester's GHG reduction goals. The fair would provide information about businesses, professional firms, organizations, and individuals offering sustainable energy products and services to Worcester residents and businesses and could be held on the City Common. Examples of vendors include green-building contractors, solar specialists, architects, energy conservation specialists, energy star representatives, clean energy suppliers, business consultants, environmental educators, and many other useful resources.

Want more info? See page 118.

36. Collaborate with Local Universities and Partner with Local Organizations

It is important for the City to partner with local organizations and universities for several reasons. 1) Combine efforts, many organizations are working on the same energy and climate change issues. 2) Make use of local resources, students are interested doing work on climate change and renewable energy. 3) Connect with the community, by collaborating with others, the City is reaching out into the community and creating a more unified approach to energy and climate change education.

Want more info? See page 117.

37. Participate in the Annual Earth Day Fair

Every year the City of Worcester partners with the Regional Environmental Council to sponsor the city-wide Earth Day clean-ups. The REC also sponsors an Earth Day Fair around the same time. Last year the REC partnered with the EcoTarium to put on a larger event. The City should participate in the annual Earth Day fair and distribute information about the Climate Action Plan, Worcester's energy goals and actions, and other environmental initiatives, such as the mercury take-back campaign, curb-side recycling, and hazardous waste collection. By having a presence and distributing brochures at the Earth Day Fair, the City can help residents to understand how they can take an active role in lowering their own energy emissions output.

Want more info? See page 118.

1.1 Global Warming and the Enhanced Greenhouse Effect

What We Know

The phenomenon known as global climate change refers to the impact of a gradual rise in the earth's surface temperature caused by an increasing concentration of greenhouse gases (GHGs) in the atmosphere. Greenhouse gas emissions are gases that trap heat in the Earth's atmosphere. Without greenhouse gases, the average global temperature would go from 59° Fahrenheit to 0° Fahrenheit.[1] The most notable greenhouse gases are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), halocarbons that contain fluorine such as hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6)[2] (see Figure 1 on the right).

While greenhouse gases such as carbon dioxide (CO_2) and methane play a vital role in maintaining the necessary conditions for life on Earth, the rapidly increasing concentrations of these gases are causing a rise in global temperature. Greenhouse gases in the atmosphere behave much like the glass panes in a greenhouse. Sunlight enters the Earth's atmosphere, passing through a blanket of greenhouse gases. As it reaches the Earth's surface, land, water and the biosphere absorb the sunlight's energy. Once absorbed, this energy is sent back into the atmosphere. Some of the energy passes back into space, but much of it remains trapped in the atmosphere by the greenhouse gases, causing an increase in atmospheric temperature. The problem that we now face is that human actions, particularly the burning of fossil fuels and land clearing are increasing the concentrations of these gases, creating the prospect of further global warming. This is the ***enhanced*** greenhouse effect.

Scientists know for certain that human activities are changing the composition of Earth's atmosphere. Increasing levels of green-

GREENHOUSE GASES[3]:

Carbon dioxide (CO_2) is emitted when solid waste, fossil fuels (oil, natural gas, and coal), wood and wood products are burned. CO_2 emissions from oil and natural gas account for 82% of the anthropogenic GHG emissions in the United States.

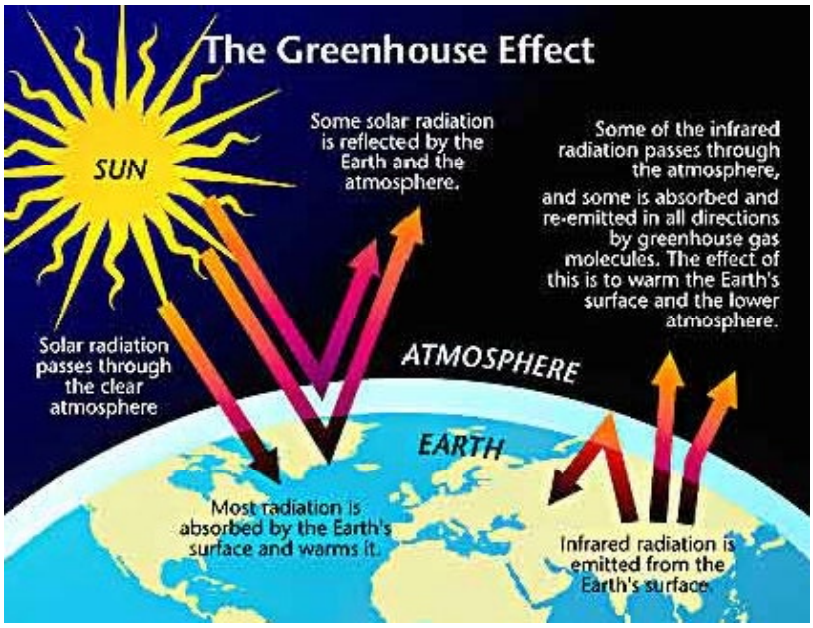
Methane (CH_4) is emitted during the production and transport of coal and natural gas. Methane emissions also result from the decomposition of organic wastes in solid waste landfills, and the raising of livestock.

Nitrous oxide (N_2O) is emitted during agricultural and industrial activities, as well as during combustion of solid waste and fossil fuels.

Other powerful, man-made greenhouse gases include **hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6),** which are generated in a variety of industrial processes.

Figure 1. *Sources of GHGs*

house gases in the atmosphere since pre-industrial times have been well documented. There is no doubt this atmospheric buildup of carbon dioxide and other greenhouse gases is largely the result of human activities.[4] A warming trend of about 1°F has been recorded since the late 19th century. Warming has occurred in both the northern and southern hemispheres, and over the oceans. Confirmation of 20th-century global warming is further substantiated by melting glaciers and decreased snow cover in the northern hemisphere.[5]



Source: NACC/USGCP graphic from Union of Concerned Scientists Website (http://www.ucsusa.org/globalwarming/index.html)

Figure 2. *Enhanced Greenhouse Effect*

What We Don't Know

As atmospheric levels of greenhouse gases continue to rise, scientists believe average global temperatures will continue to rise as a result. How fast and by how much remain uncertain. The Intergovernmental Panel on Climate Change (IPCC), a group of over 2,500 climate scientists from around the world, projects further global warming of 2.2-10°F (1.4-5.8°C) by the year 2100. This range results from uncertainties in the amount of greenhouse gas emissions, the possible cooling effects of atmospheric particles such as sulfates, and the climate's response to changes in the atmosphere. The IPCC states that even the low end of this warming projection "would probably be greater than any seen in the last 10,000 years, but the actual annual to decadal changes would include considerable natural variability."[6]

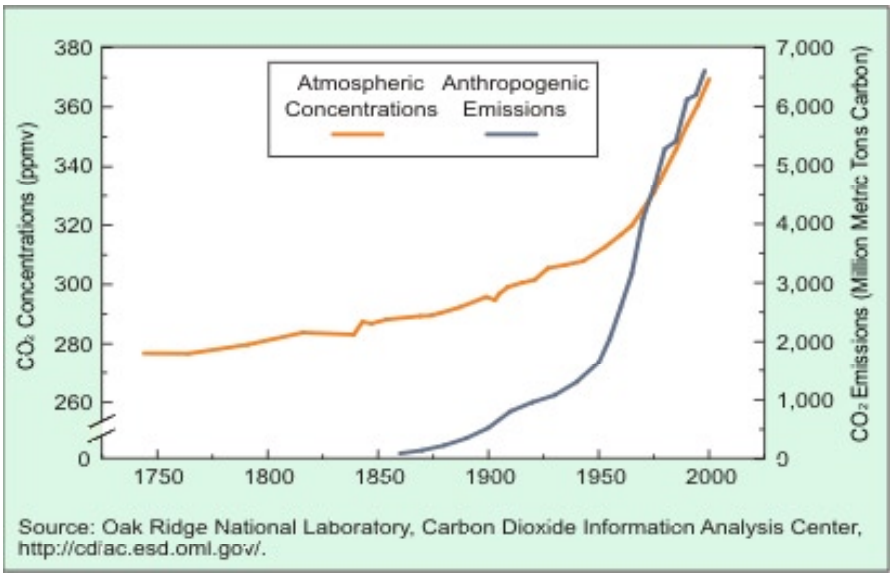


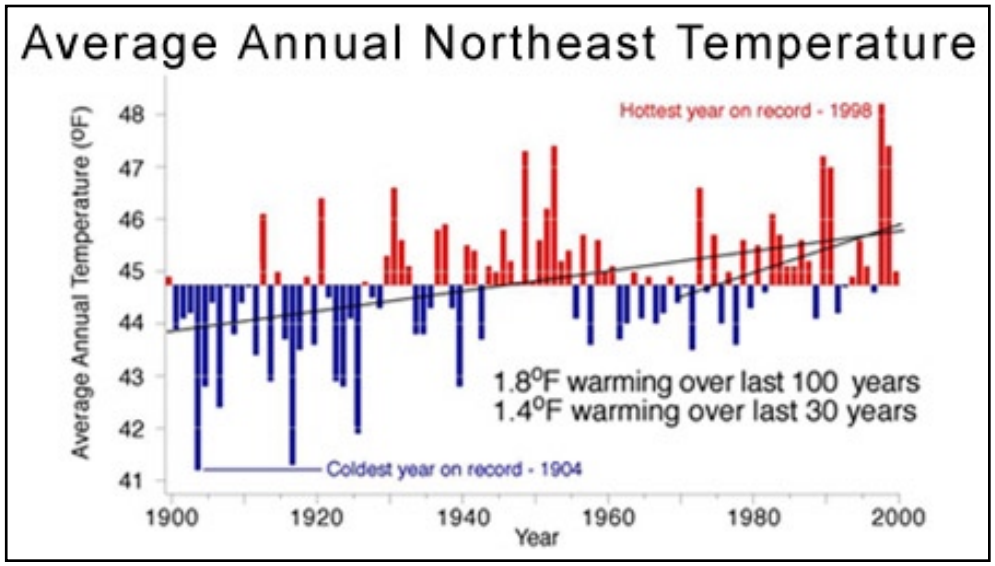
Figure 3. *Atmospheric Concentrations of Greenhouse Gases in Relation to Anthropogenic Emissions: 1750-2000*

This rise in global temperature will lead to climate change. It is impossible to be 100% certain of the impacts, as each area of the world will experience climate change differently. The IPCC predicts that impacts

of GHG emissions include an increase in the frequency and severity of floods, drought, and blizzards, a rise in sea level affecting coastal areas, and changes in precipitation patterns that would impact water supply and food production. Climate change poses both global and local risks to human and ecosystem health, as well as to sources of economic revenue such as agriculture, forestry, and fisheries.[7]

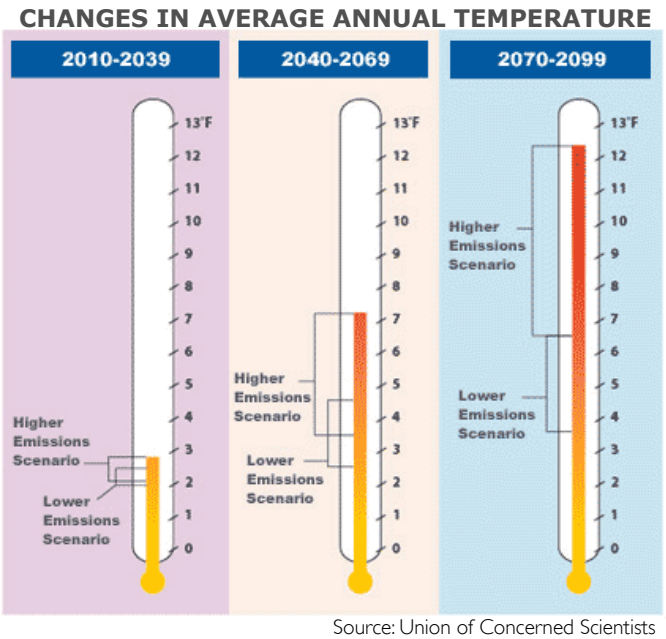
Why We Cannot Wait To Act

Because climate systems are complex and the nature and extent of the impacts can not be predicted with complete certainty, some people advocate delaying action. Although it is difficult for scientists to know the subtleties of climate and weather before they happen, 98% of scientists report that climate change is and will continue to affect us. To slow global warming, and lessen the impacts of climate change, we must lower the concentration or total amount of greenhouse gases in the atmosphere. We will have to adapt to some level of climate change, but, how much and under what circumstances, is up to us if we act now.



Source: National Oceanic and Atmospheric Administration - National Climatic Data Center

Figure 4. *Avg. Annual Northeast Temperature 1900-2000*



Source: Union of Concerned Scientists

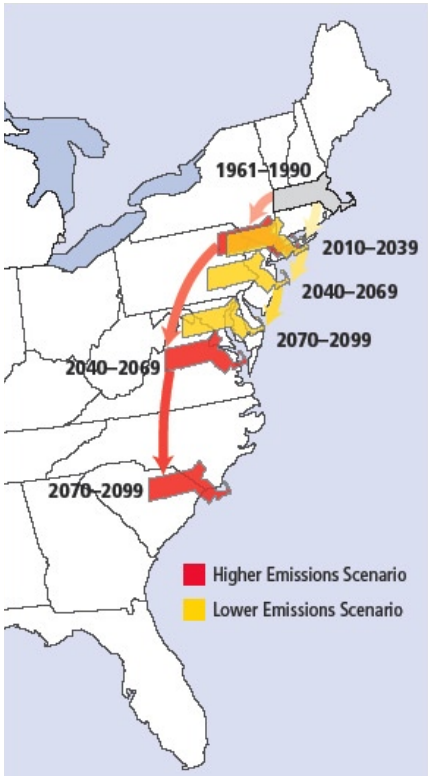
Figure 5. *Predicted Temperature Increases in the NorthEast*

Currently, the rate of human-made GHG emissions is roughly double the rate of removal. Consequently, emissions must fall by at least half to stabilize GHG concentrations at current levels, and even more to lower the concentration. Scientists indicate that ultimately emissions need to fall to 75-85% of current levels.[8] Waiting to take action is dangerous because of the nature of GHGs. When carbon dioxide is emitted into the atmosphere through the burning of fossil fuels in vehicles, buildings, or power plants, it will stay there for 50 to 200 years.[9] This means the warming trend cannot be reversed quickly. The longer we wait to act, the worse the

problem becomes. This plan proposes that Worcester join other communities and take action now to protect our health, economy, and environment rather than gamble that climate change will not affect us. Without current action, we will face more drastic and expensive impacts in later years.

1.2 The Response to Climate Change

Scientific evidence indicates that the accelerated emissions of greenhouse gases is altering the global climate. In response, organizations at international, national, and local levels have initiated actions to reduce these emissions. Efforts include:



Source: Union of Concerned Scientists

Summers in Massachusetts
Summer in Massachusetts could feel like the typical summer in South Carolina by the end of the century unless we take action to reduce heat-trapping emissions today.

Figure 6. *Summers In Massachusetts*

1.2.1 The Intergovernmental Panel on Climate Change (IPCC)

In 1988, the United Nations Environment Programme and the World Meteorological Organization created the IPCC to conduct studies on global warming. Efforts undertaken include identifying emission sources, assessing possible consequences, and developing mitigation strategies.[10]

1.2.2 Kyoto Protocol

The Kyoto Protocol is an amendment to the United Nations Framework Convention on Climate Change (UNFCCC), an international treaty on global warming. It is a legal agreement under which industrialized countries who agree to participate will reduce their collective emissions of greenhouse gases by 5.2% compared to the year 1990 (but note that, compared to the emissions levels that would be expected by 2010 without the Protocol, this target represents a 29% cut). The goal is to lower overall emissions from six greenhouse gases (carbon dioxide, methane, nitrous oxide, sulfur hexafluoride, HFCs, and PFCs) calculated as an average over the five-year period of 2008-12. Countries which ratify the Protocol commit to reduce their emissions of carbon dioxide and the five other greenhouse gases, or engage in emissions trading if they maintain or increase

emissions of these gases. As of October 2006, a total of 166 countries, including the European Union, Canada and Japan, have ratified the agreement. Notable exceptions include the United States and Australia. The formal name of the agreement is the Kyoto Protocol to the United Nations Framework Convention on Climate Change. It was negotiated in Kyoto, Japan in December 1997, opened for signature on March 16, 1998, and closed on March 15, 1999. The agreement came into force on February 16, 2005, following ratification by Russia in November of 2004. Thirty industrialized countries have committed to cutting their greenhouse gas emissions by approximately five percent below 1990 levels. While this represents an ambitious start, it is not ambitious enough to reduce future impacts on the global climate.[11]

1.2.3 Regional Greenhouse Gas Initiative

The Regional Greenhouse Gas Initiative (RGGI), developed by the Northeast Governors and led by New York Governor George Pataki, is a multi-state effort aimed at creating a program to control emissions of CO_2 from the electricity sector. The Governors and their environmental and energy agency leaders are developing a model rule that each state will implement and a system to trade CO_2 permits among power plants in different states. In October 2005, Massachusetts Governor Mitt Romney pulled out of the RGGI talks; however, local cities such as Amherst, MA, Newton, MA, Keene, NH, and New Haven, CT are urging their state governments to move the developing program model forward. This Climate Action Plan establishes strategies to achieve Worcester's CO_2 emission reduction goal of 11% below 2002 levels by 2010. At the regional level, the New England governors and the Eastern Canadian premiers issued a Climate Change Action Plan in August 2001, which calls for the reduction of greenhouse gases to 10% below 1990 levels by 2020. The efforts of the RGGI and the regional cap-and-trade program will assist all participating states and municipalities in reaching their local goals.[12]

1.2.4 US Mayors Climate Protection Agreement

On February 16, 2005 the Kyoto Protocol, the international agreement to address climate change, became law for the 166 countries that have ratified it to date (Oct 2006). On that day, Seattle Mayor Greg Nickels launched this initiative to advance the goals of the Kyoto Protocol through leadership and action by local governments in America. Mayor Nickels, along with a growing number of other US mayors, is leading the development of a US Mayors Climate Protection Agreement; the goal was for at least 141 cities to sign onto the Agreement by the time of the U.S. Conference of Mayors June 2005 meeting in Chicago. As of October 19, 2006 signatories included 320 mayors from 46 states representing a total population of 51.6 million Americans. Worcester residents can be proud that Worcester's Mayor, Timothy P. Murray, joined ten

other mayors in signing on. Other Massachusetts mayors include: Thomas M. Menino – Boston, Michael A. Sullivan – Cambridge, Richard C. Howard – Malden, Michael J. McGlynn – Medford, and David B. Cohen – Newton.

Under the Agreement, participating cities commit to take the following three actions:

- Strive to meet or beat the Kyoto Protocol targets in their own communities, through actions ranging from anti-sprawl land use policies to urban forest restoration projects to public information campaigns;
- Urge their state governments and the federal government to enact policies and programs to meet or beat the greenhouse gas emission reduction target suggested for the United States in the Kyoto Protocol -- 7% reduction from 1990 levels by 2012; and
- Urge the U.S. Congress to pass the bipartisan Climate Stewardship Act, which would establish a national emissions trading system[13]

1.2.5 Urban Environmental Accords

The signing of the "Urban Environmental Accords" capped the United Nations World Environment Day Conference in San Francisco that took place from June 1-5, 2005. The nonbinding accords list 21 specific actions that can make cities greener. Mayors from around the world signed the international treaty calling for 21 action steps in the areas of Energy, Waste Reduction, Urban Design, Urban Nature, Transportation, Environmental Health, and Water. Cities attempt to implement as many of the steps as possible in the next seven years and are awarded a certain level of achievement according to the number of specific actions completed.[14] Worcester has not yet signed on to the accords. See Appendix M for the accords text.

1.3 Global Impacts of Climate Change

The impact of climate change will involve more than hotter temperatures. Among other effects, it may produce increased incidences of extreme weather events, like hurricanes and storms; melting of the polar ice sheets, which could result in a rise in overall sea levels and lead to coastal flooding, water resource contamination, and increased stress on ecosystems, in turn leading to desertification and/or loss of biodiversity; increases in the earth's average temperature and precipitation levels; and other dramatic climate transitions which may not easily be predicted. These environmental impacts will affect society, particularly in agricultural and food production, fisheries stocks, air quality and ozone levels and human health.[15] The consequences of global warming and climate change are far reaching, and can affect all countries, states and cities, regardless of socio-economic status or location. Local and state governments, businesses, institutions, and citizens will bear the brunt of adapting to these changes through payment for public works projects, insurance premiums, and disaster response.

1.4 Impacts of Climate Change in Massachusetts

While climate change is a worldwide phenomenon, the impacts will be felt locally. In the state of Massachusetts, the effects of climate change are already apparent. The average temperature has increased by 2% over the past century, with precipitation levels rising by up to 20% in some parts of the state. This trend will more than likely continue through the next century. Projections from the IPCC show that by the year 2100, average temperatures in Massachusetts are expected to increase 4°F in the winter and spring, and 5°F in the summer and fall. This may lead to increased heat waves in the summer, which will elevate heat-related deaths especially in urban areas like Greater Boston. Studies have projected that by 2050, if no action is

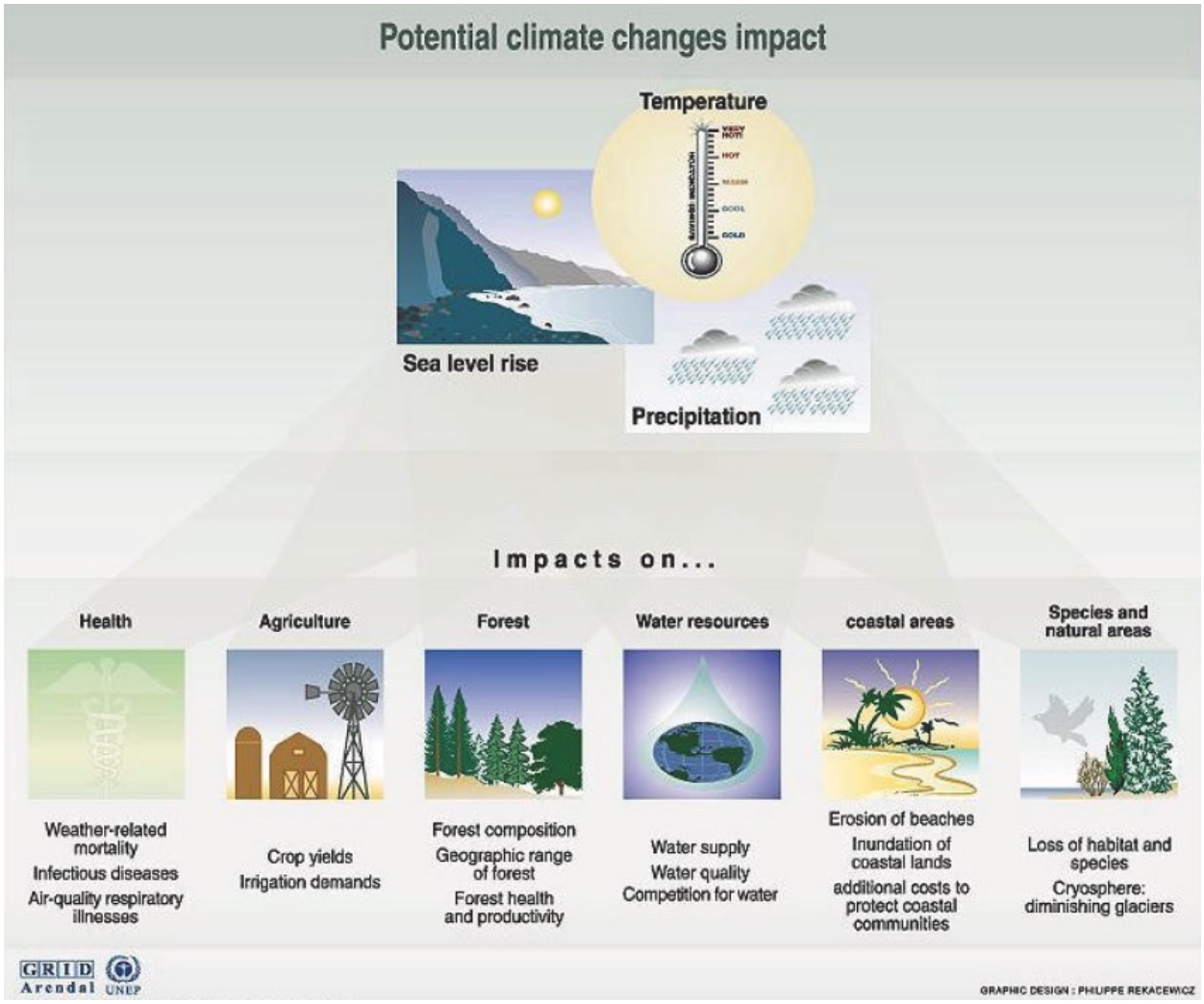


Figure 7. *Potential Impacts of Climate Change*

Source: United States Environmental Protection Agency (EPA)

taken, heat-related deaths during a typical summer could increase 50%, from close to 100 per summer to over 150. Ground level ozone may also increase as a result, causing an increase in symptoms associated with asthma and other respiratory diseases.[16]

In addition, the sea level in the Greater Boston area has risen 11 inches in the last century, and it is

expected to rise another 22 inches by the year 2100. This sea level rise could cause excessive erosion of Massachusetts' coastal areas. General weather patterns may change, bringing an increase in precipitation, which can lead to extremes like flooding, water scarcity and threats to water quality. Increased incidence of intense weather events, like heavy storms and hurricanes, may also occur, creating stresses on forests, fisheries and agricultural lands. The coastal beaches and tidal marshes of Massachusetts are especially sensitive to the effects of sea level rise and changes in river flows. Sea level rise could inundate coastal wetlands, destroying habitat for migratory birds and other wildlife. Barrier beach island refuges such as the Monomoy National Wildlife Refuge south of Cape Cod could be threatened or lost.[17]

The potentially damaging impacts of climate change on Massachusetts forests would also be significant. Major ice storms and changing weather patterns have severely impacted the New England maple syrup industry over the past century, creating ecological, economic and cultural concerns. Northern hardwoods, spruces, and fir trees could migrate 100 to 300 miles north, and would likely be replaced by southern and successional species. The trees producing some of the most spectacular fall foliage in the Commonwealth, an important part of the regional landscape heritage and tourism, may give way to the pressure of thinning forests attributed to an increased vulnerability to disease.[18]

1.5 What can Worcester do about Climate Change?

A certain amount of climate change is now inevitable and will affect many generations to come because of the persistence of greenhouse gases in the atmosphere once they have accumulated there. Preventing the most catastrophic effects will require a global commitment to stabilize CO_2 concentrations to as close to current levels as possible. Such stabilization requires that CO_2 emissions be reduced to less than half their current levels globally.[19] While this is a very ambitious goal, there are effective ways to reduce these emissions; individuals, businesses, and governments should be encouraged to implement these actions today.

To demonstrate the feasibility of such reductions and to set examples that will motivate our national political bodies, many cities and towns—and even entire states and regional partnerships— across the country have decided to begin reducing their greenhouse gas emissions now. At its most basic level, after all, the concentration of CO_2 and other greenhouse gases in the atmosphere is the cumulative result of billions of individual behaviors: the kinds of vehicles we drive and how much we drive them; how we heat and cool our homes and businesses; the efficiency of our appliances and other machinery; the kinds of lighting we use; how much we reuse and recycle consumer goods; even the number of trees in our neighborhoods and the quality of our natural areas and open spaces. While Worcester's contribution to climate change is

a minuscule part of the global total, our efforts as a community to reduce local greenhouse emissions can encourage other communities to follow our lead, building momentum for a global solution.

There are numerous ways to make these reductions and many offer the additional benefits of reducing fuel costs and other harmful air pollutants. Some approaches are more effective than others. Some will begin to save money almost immediately, while others will require an initial investment that will be recovered over time—usually a short time. In August 2001, the New England Governors and Eastern Canadian Premiers issued a Climate Change Action Plan for the region calling for reduction in greenhouse gas emissions to 1990 levels by the year 2010 with a long-term goal of reduction of 75-85 percent. A number of municipalities are heeding the call to action by writing and implementing their own plans. This is a chance for Worcester to be among the leaders, and set an example for its residents, who all make countless energy consumption decisions in their lifetimes.

1.6 The Cities for Climate Protection Campaign® and the City of Worcester's Energy Task Force

The Cities for Climate Protection (CCP) Campaign is a global project of ICLEI- Local Governments for Sustainability (ICLEI), which is an international membership association of local governments dedicated to the prevention and solution of global environmental problems through local action. ICLEI currently oversees three campaigns, one of which is the Cities for Climate Protection (CCP) Campaign. This Campaign was established by ICLEI in 1993 at an international summit of municipal leaders held at the U.N. Headquarters in New York. The CCP campaign has engaged over 770 municipal governments in a worldwide effort to slow the earth's warming. As of September 2006, the participating local government authorities in Massachusetts include Amherst, Arlington, Barnstable, Belmont, Boston, Brookline, Cambridge, Falmouth, Gloucester, Hull, Lenox, Lynn, Medford, Natick, Newton, Northampton, Pioneer Valley Planning Commission, Reading, Salem, Shutesbury, Somerville, Springfield, Watertown, Williamstown, and Worcester.[20]

In February 2006, City Manager, Michael V. O'Brien, appointed fourteen representatives from municipal departments, utilities, businesses, universities and environmental organizations to the Energy Task Force (ETF). The ETF is chaired by Dr. Stephen Willand, Director of Workforce Development, and managed by Worcester's Energy Consultant, Carissa Williams. The mission of the ETF is to create a step-by-step plan to reduce energy consumption, reduce greenhouse gas emissions and increase the use of clean, renewable energy in a cost effective manner in the city of Worcester. To carry out their mission, the ETF has set forth some tangible goals:

- Decrease greenhouse gas emissions 11% below 2002 levels by 2010
- Make significant progress towards increasing the use of renewable electricity in municipal opera-

tions to 20% by 2010

- Save money on energy costs
- Gain public acceptance for Worcester's Climate Action Plan
- Educate residents of Worcester on how to reduce GHG emissions and other air pollution
- Act as a leader for other local governments

There are several areas that need to be given attention in order to fulfill these goals; these include, Renewable Energy, Transportation, Energy Efficiency, Solid Waste, Green Space, Public Outreach and Education, Communications (publicity for municipal reductions, communications with state/regional climate organizations), Data Collection and Analysis, and Finances (identify and secure funding opportunities, determine the most cost-effective ways to implement reduction measures). The task force meets bi-monthly to discuss the progress in these areas, with sub-committees on Renewable Energy, Energy Efficiency, and Transportation meeting in between.

Worcester's Energy Task Force has approved the slogan and logo "Clean and Green" to represent the ETF's mission and the City's endeavors to reduce greenhouse gas emissions and support the development of clean, renewable energy. The ETF strives to educate the community on the actions Worcester is taking and the role that individuals can play in reducing GHG emissions by using the slogan, **"Worcester, the GREEN heart of the Commonwealth"**.

1.7 The Five Milestone Process

The Cities for Climate Protection Campaign follows a 'Five Milestone' process:

- Milestone One: Conduct a Greenhouse Gas Emissions Inventory and Report for the entire community as well as municipal operations
- Milestone Two: Set a Greenhouse Gas Emission Reduction Target
- Milestone Three: **Develop a Local Climate Action Plan**
- Milestone Four: Implement the Local Climate Action Plan
- Milestone Five: Monitor Emission Reductions

1.8 The Climate Action Plan

1.8.1 Purpose of the Climate Action Plan

The primary purpose of this plan is to reduce the GHG emissions that cause climate change, but actions that reduce GHG emissions also achieve other goals. In fact, many actions already taken in Worcester for other reasons have reduced our GHG emissions. Benefits of energy and climate planning include:

- **Reduce air pollution / Improve public health:** Burning fossil fuels results in the emission of conventional air pollutants that cause smog and other air quality problems. By reducing fossil fuel use through efficiency and switching to alternative fuels, actions can reduce GHGs while decreasing conventional air pollution. Energy planning can minimize air pollution-related illness and promote healthier lifestyles. There is also overwhelming evidence that high performance buildings - commercial structures designed to minimize energy consumption and maximize use of space - are healthier buildings for working, studying, and living.

- **Save money:** Using fuels and electricity more efficiently can lower operating costs. The potential for financial savings is enormous for all sectors of the community. A typical single family household can save $300 per year by implementing simple energy conservation measures. Savings can then be used for other purposes. See Section Three, page 56 for more information.

- **Improve energy security:** Petroleum and its products, such as gasoline, are a major source of GHG emissions. The United States depends on petroleum imports from other countries for over 50% of its demand. Reducing petroleum use makes us less vulnerable to disruptions in supply. This issue will be of utmost importance over the next few years with the dramatic rise in energy demand in Asia and other parts of the world. Lowering demand for fossil fuels also helps send a signal to utility companies to clean up their old, polluting power plants.

- **Improve livability:** Encouraging walking and bicycling will cut transportation energy consumption, while improving public health and fitness, strengthening the community by generating business opportunities, reducing parking problems, and enhancing recreational opportunities. In addition, actions that reduce automobile dependency can decrease traffic congestion and localized air pollution. Planting trees cools summer air temperatures, and recent studies prove that natural environments reduce crime and violence and encourage concentration and self-confidence. All of these actions can make Worcester a nicer place to live and work.

- **Economic Vitality:** Increasing the use of renewable energy facilitates innovation, creates jobs, and over time makes these emerging technologies more cost effective. New energy efficient and financially beneficial solutions in building design and construction are gaining momentum. The number of small companies specializing in energy design and technologies in Massachusetts is growing, and this is an opportunity to strategically attract these businesses to Worcester.

Ultimately, however, Worcester should act in order to take responsibility for its share of GHG emissions.

1.8.2 Structure of the Climate Action Plan

This plan proposes to establish a process to start the reduction of GHG emissions, primarily CO_2, in Worcester. The following sections describe Worcester's GHG emissions; set an emission reduction target and strategy; identify possible actions to reduce GHG emissions; identify resources and programs available to address these areas; and propose implementation steps. The plan proposes rather than prescribes actions. It also proposes steps to engage the entire community, so that businesses, institutions, and individuals - along with government - can develop appropriate responses in a coordinated process with ongoing monitoring of results and adjustments.

The Climate Action Plan should be considered an organic document and should be updated as needed to include completed reduction measures, new or revised reduction measures, updated emissions inventories, and updated reduction targets.

Section Two: Greenhouse Gas Emissions Inventory and Reduction Target

2.1 2002 Greenhouse Gas Emissions Inventory

Conducting a greenhouse gas emissions inventory is the first step toward reducing GHGs in our atmosphere. To appropriately manage Worcester's GHG emissions, the City first assesses the emission origins and current levels. The first emissions inventory for the city of Worcester was completed in April 2004 by Energy Consultant, Carissa Williams, as a part of her master's work at Clark University. The data were collected for the 2002 calendar year when possible and the 2002-2003 fiscal year otherwise. The Energy Task Force has updated the 2002 GHG emissions inventory to include more sources and more detailed and accurate data. This section of the Action Plan outlines the results of the emissions inventory.

Data Collection

To find out how many tons of GHG emissions Worcester emits, the following data were collected:

Fuel types and data sources:

- Electricity – Massachusetts Electric (now National Grid), Select Energy, Water Filtration Plant, UBWPAD
- Natural Gas – NSTAR, Select Energy, UBWPAD
- Heating Oil – Purchasing Department, Energy Information Administration (EIA), US Census 2000, UBWPAD
- Gasoline – Purchasing Department, Mass Highway, CMRPC
- Diesel – Purchasing Dept., Mass Highway, CMRPC, Durham School Bus
- Waste – DPW, Wheelabrator Incinerator

Fuel data were collected from each of the following sectors:

- Residential
- Municipal
- Commercial / Industrial
- Waste
- Transportation

CACPS Software Inputs and Outputs

Once the amount of fuel used annually by the various sectors in the city was known, this data was input into a computer software program called Clean Air Climate Protection Software (CACPS, see Section 2.2). The input data included:

- kWh of Electricity
- Therms of Natural Gas
- Gallons of Heating Oil
- Thousand gallons of Gasoline and Diesel
- Million vehicle-miles traveled (VMT) per year
- Tons of Waste Incinerated
- Tons of Waste Composted
- Tons of Waste In Place

The input fuel data were then converted by the CACPS to calculate the annual GHG and criteria air pollutant emissions generated. The data output is the amount of equivalent carbon dioxide (eCO_2) emitted[21], the amount of energy consumed, and in some cases the total cost of this consumption. Also included in the data output are the emissions of the five criteria air pollutants nitrous oxides (NO_X), sulfur oxides (SO_X), VOCs (volatile organic compounds), carbon monoxide (CO), and particulate matter with a diameter of 10 micrometers or less (PM_{10}).

Results

The results of the greenhouse gas emissions inventory are shown in the following figures. The data behind these figures can be found in Appendix E. The term community is used to mean the entire city of Worcester not including the municipality, and the term municipal is used to refer to the city government operations, including the UBWPAD sewage treatment plant as Worcester provides 90% of the waste processed.

The majority of emissions are produced from transportation, housholds, and businesses, with municipal emissions making up a smaller, but meaningful, portion.

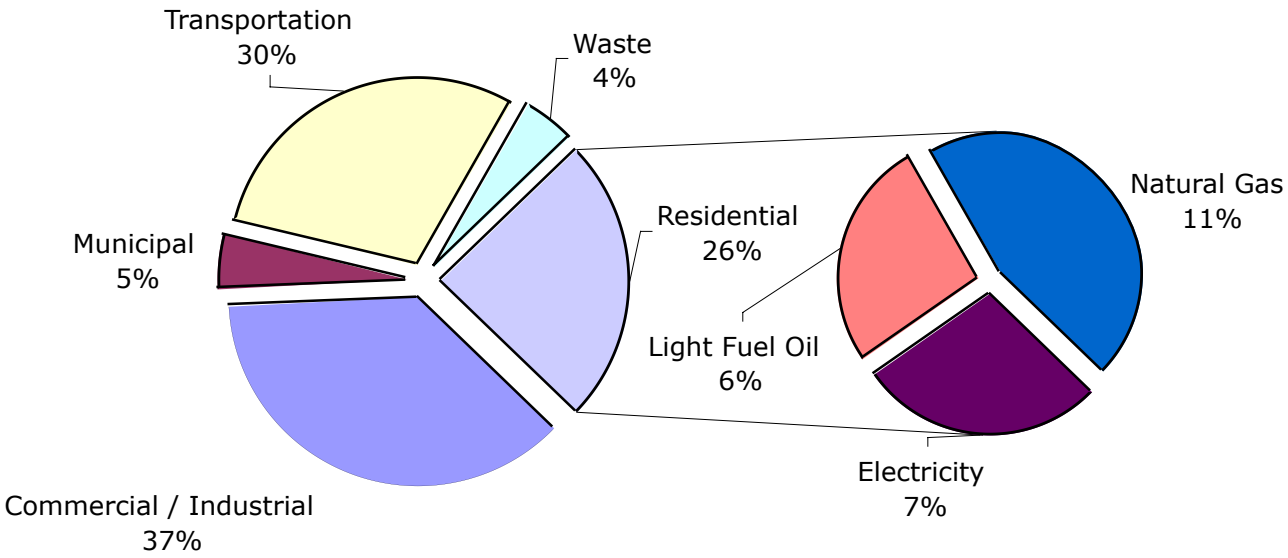


Figure 8. *Worcester's Greenhouse Gas Emissions by Sector: Residential GHG Emissions Broken Down by Source*

The most efficient fuel in Figure 9 is natural gas; more energy is produced by natural gas per ton of eCO_2 emitted than by electricity or light fuel oil. The importance of Figure 9 is to show that though natural gas is responsible for the majority of residential emissions (Figure 8), the solution is not to reduce the use of natural gas by increasing the use of more polluting fuels.

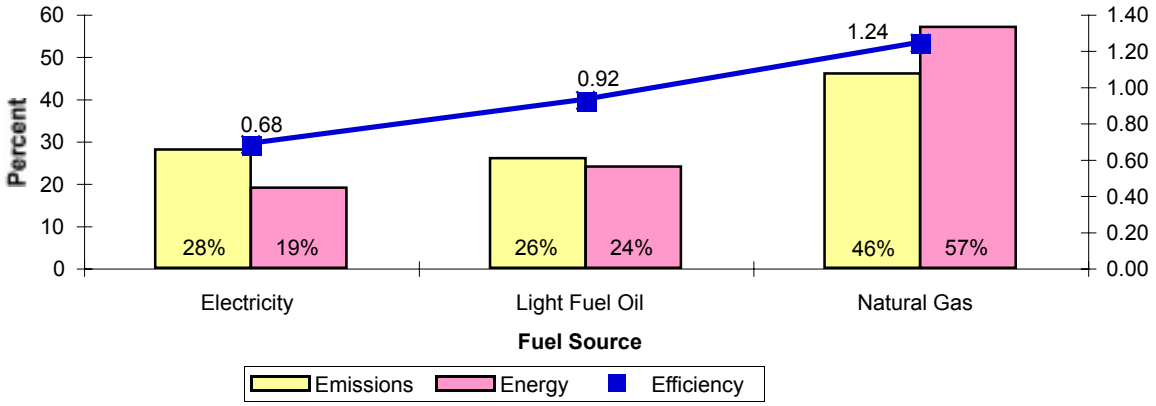


Figure 9. *The Efficiencies of Fuels: Residential Greenhouse Gas Emissions vs. Energy Produced*

City/Town	Data Year	Total GHG Emissions*	GHG Emissions per Capita*
Brookline, MA	1995	647,174	11.8
Cambridge, MA	1990	1,699,378	17.7
Burlington, VT	1990	438,931	11.2
Medford, MA	1998	745,349	13.0
Newton, MA	2002	1,144,222	13.6
Worcester, MA	2002	2,209,185	12.6

* tons of eCO_2 (City of Newton's Energy Action Plan 2004)

Figure 10. *GHG Emissions of Select CCP Communities*

Figure 10 shows the total GHG emissions of select CCP communities in tons of eCO_2. While Worcester generates significantly more emissions than any of the above cities, the emissions per capita are comparable; Worcester is not an outlier when its large population size is considered. Our large amount of emissions provides an opportunity as well as a call to duty for Worcester to be a leader in the state and to produce significant emission reductions.

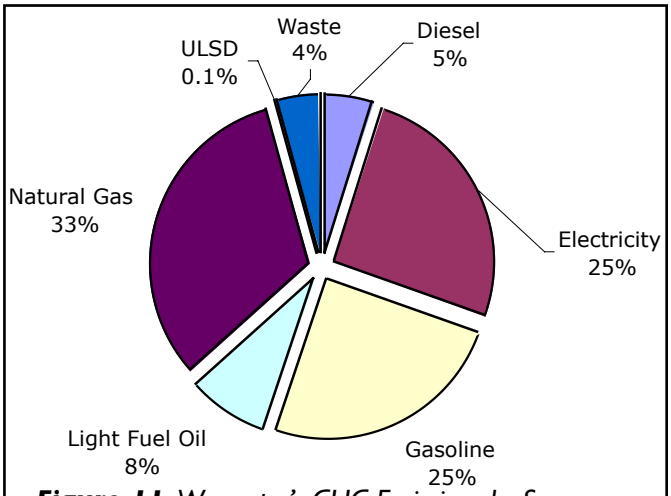


Figure 11. *Worcester's GHG Emissions by Source*

Criteria air pollutants are regulated by the EPA under the Clean Air Act. Figure 12 shows the pounds of criteria air pollutants emitted by the Worcester community each year per capita, along with the tons of eCOs emitted and the energy consumed per capita.

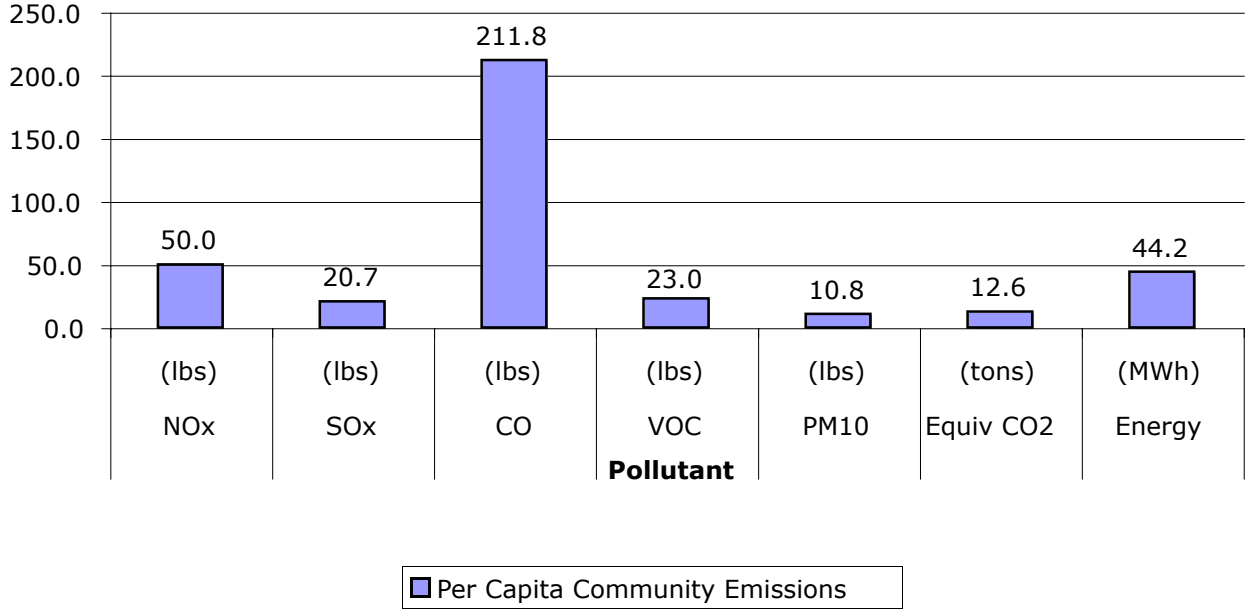


Figure 12. *Worcester Criteria Air Pollutants and GHG Emissions per Capita*

The vast majority of municipal greenhouse gas emissions come from energy consumed by buildings and waste generation, while vehicle emissions also play a large role.

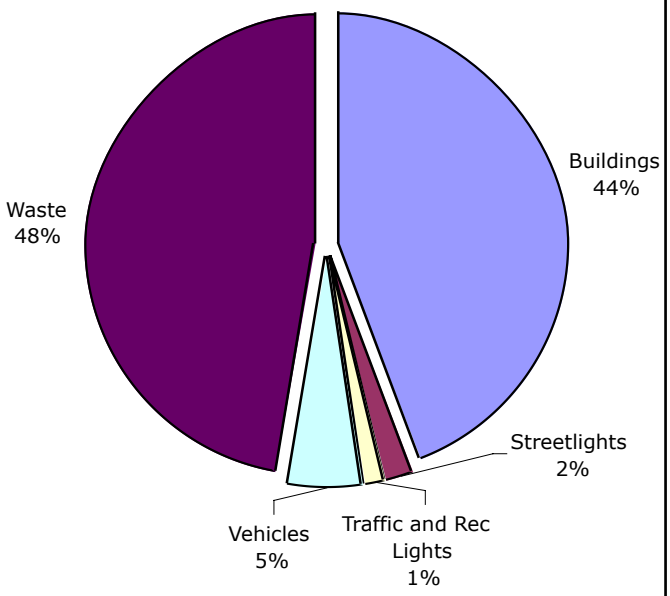


Figure 13. *Municipal GHG Emissions by Sector*

Figure 14 begins to breakdown emissions from the Municipal buildings. It is clear to see that the largest contributors of emissions are school buildings.

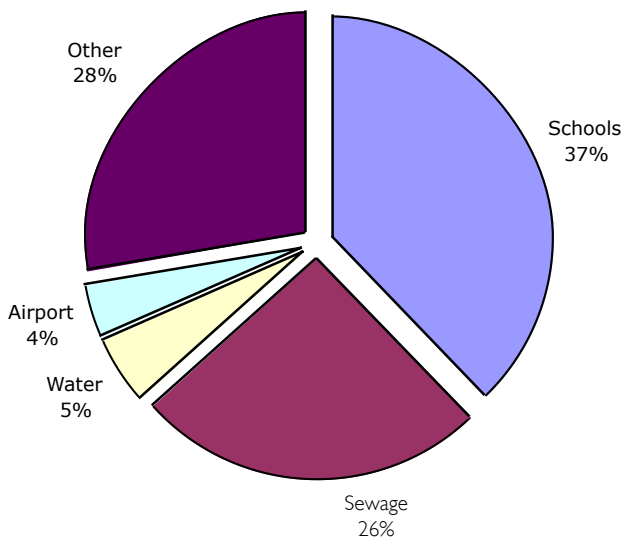


Figure 14. *Electricity Consumed by Municipal Buildings*

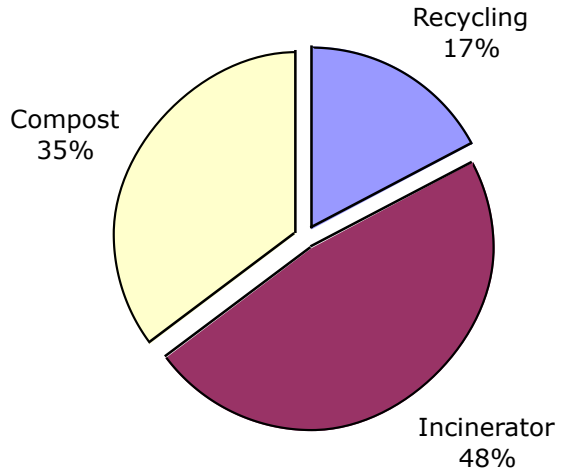
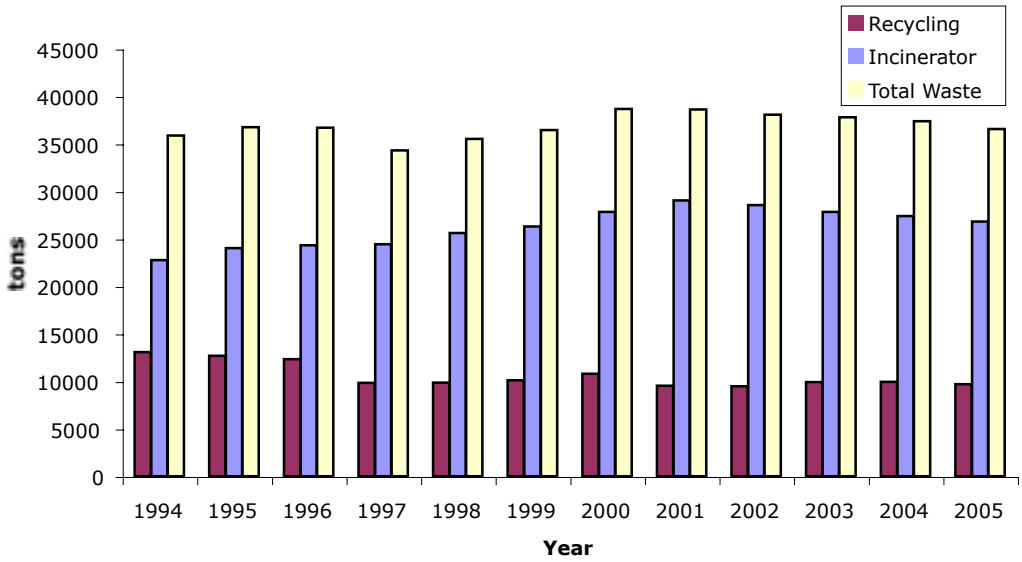


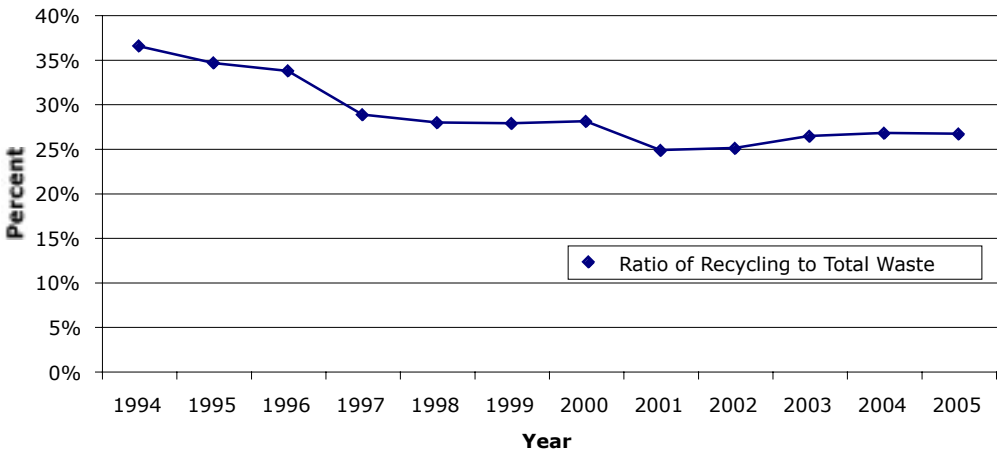
Figure 15 shows the break-down of waste in the community. Worcester's composting program is reducing a significant amount of incinerated waste and is reducing greenhouse gas emissions in the process.

Figure 15. *2005 City-Wide Solid Waste Stream*



Figures 16 and 17 show Worcester's recycling rate. Figure 16 shows the tons of recycling, the tons of trash incinerated, and the sum of the two waste streams for each year from 1994-2005. The amount of waste recycled is significantly less than the amount incinerated.

Figure 16. *Worcester's Waste Stream: Recycling vs. Trash 1994-2005*



The recycling rate is on a declining trend.

Figure 17. *Percent of Recycling in Worcester's Waste Stream*

Figure 18 shows the average amount of electricity consumed per household each year from 1997-2002. The steady increase shows a growing electricity demand in homes.

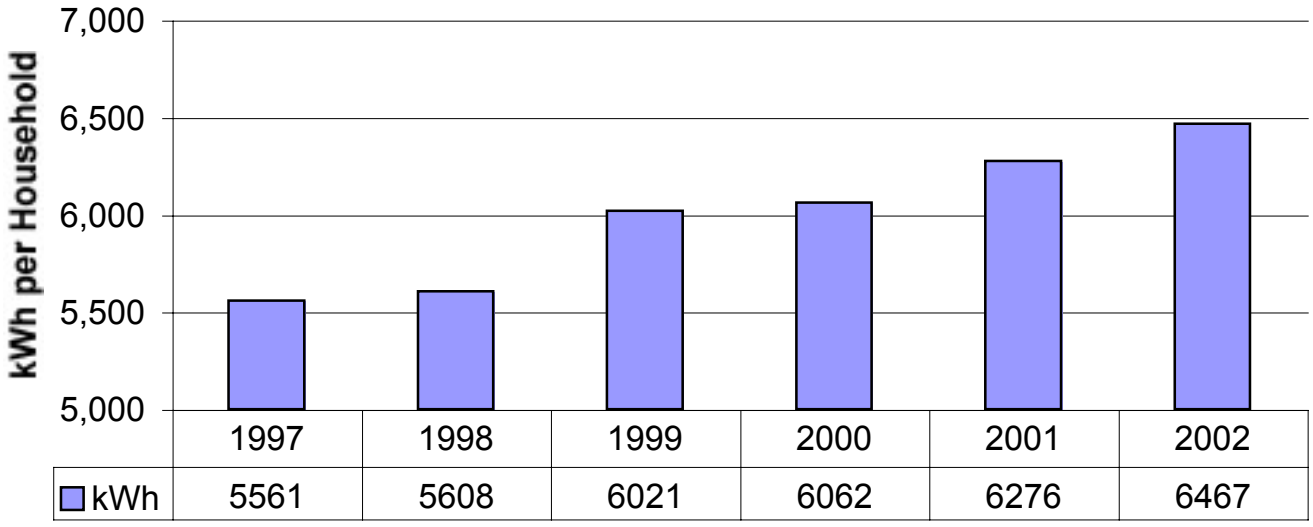


Figure 18. *Annual Electricity Consumption per Worcester Household*

Some pieces of the emissions inventory data are more accurate than others. The purpose of the inventory is to find the largest sources of GHG emissions, and hence to reveal where reduction efforts should be focused to maximize results. While the data may not be perfect, the Energy Task Force believes that the quality of the data is able to serve the purpose of the study and enable the City to effectively manage energy consumption.

Emissions Inventory Update

It is important that departments keep good records of their energy use and costs. Many departments have been doing this for years, while others are just beginning. As the Energy Manager works with the departments and data collection becomes better, the detail and accuracy of the emissions inventory will increase and the City will be able to learn more about the uses of energy in municipal operations and the amount of tax dollars that go to support them. If good records are kept, it will be easy for the Energy Manager to update the emissions inventory on a yearly basis - tracking Worcester's energy demand and the actual effect of the greenhouse gas reductions measures that have been implemented. To learn more about data collection see Section 4.4.

2.2 Clean Air and Climate Protection Software

Emissions data for Worcester's GHG Emissions Inventory and the measures included in this Climate Action Plan were quantified using the Clean Air and Climate Protection Software (CACPS) Version 1.0 June 2003, a product created for ICLEI to assist local communities with the CCP process. The software can be used to track progress as reduction measures are implemented and to update the emissions inventory. CACPS has been developed for and is supported by ICLEI to allow local governments to meet the CCP milestones. The methodologies and assumptions behind the software emission calculations are discussed in Appendix E.

ICLEI is currently developing a new web-based software tool, Harmonized Emissions Analysis Tool (HEAT), which will have more capabilities than CACPS. HEAT has already been released in Brazil, India, and South Africa. A 2007 release in the US is anticipated. As a member of ICLEI and CPP, Worcester will have access to this new software when it is released.

2.3 Municipal Reduction Target

The purpose of setting a reduction target is to create a goal that will encourage people to strive for emission reductions while still remaining attainable. There are two types of targets that can be set in a Climate Action Plan: a municipal target, which refers to the GHG emissions generated only by the municipal operations, and a community target, which refers to all emissions generated by the city.

The Energy Task Force suggests Worcester set a municipal GHG emission reduction target of 11% by 2010 based on 2002 emission levels. The suggested target translates into a 7% emission reduction of 1990 levels by 2010. This target was chosen because it aligns with the first step in the Kyoto Protocol of reducing emissions 7% from 1990 levels by 2010-2020, and because the task force believes it to be an achievable target.

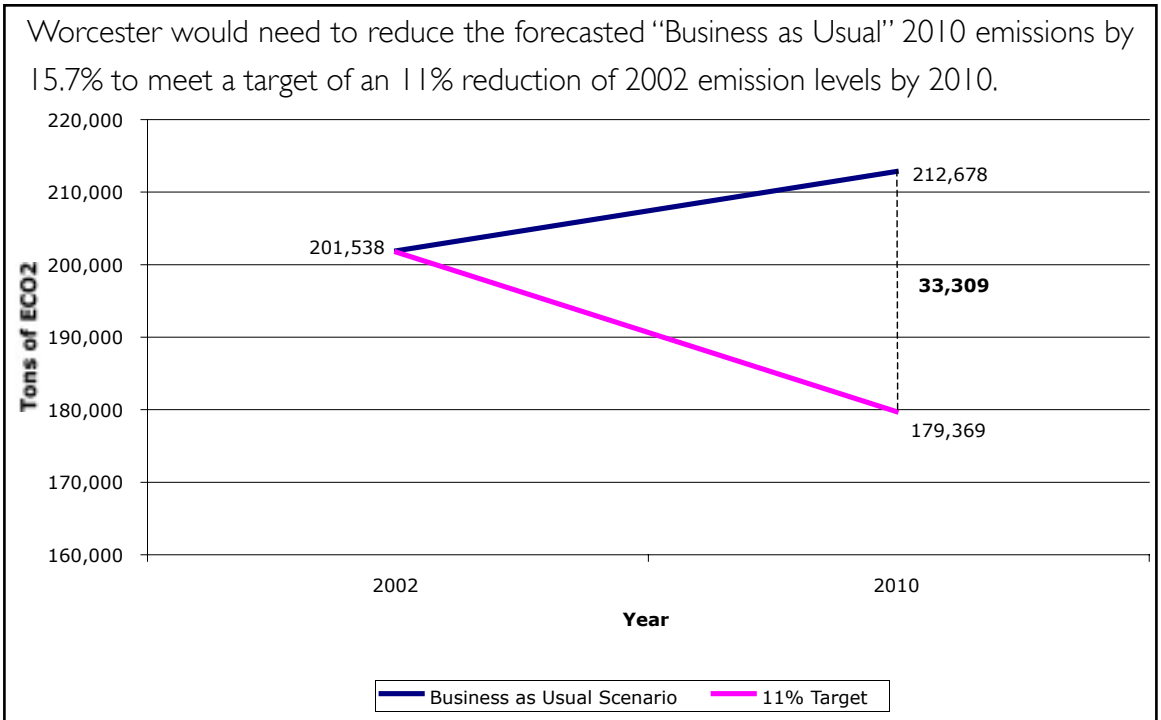


Figure 19. *Business as Usual vs. 11% Reduction Target*

2.4 Creating New Reduction Targets

The municipal reduction target should be reviewed periodically, at least two years before the target date (i.e. 2008 for a 2010 target date). Upon review, the next target year and goal should be set based on the completed reduction measures and new proposed measures.

A community reduction target should also be set. Before any further work to engage the community is carried out, indicator data should be collected to measure the success of outreach and education programs. Indicators may include the number of households and small businesses getting energy audits, the average amounts of electricity and natural gas used per household each year, and the community wide vehicle make-up. Like the municipal target, the community target should also be reviewed and updated as new reduction measures are implemented. The first community reduction target should be set no later than 2007.

Section Three: Emission Reduction Measures

There is no single "silver bullet" for achieving major reductions in Worcester's energy use and emissions. Meeting the 11% municipal goal and future community targets will require a concerted and coordinated effort to introduce many changes in technology, professional and business practices, and behavior.

This section provides many recommendations for reducing Worcester's energy use and resulting greenhouse gas (GHG) emissions. The section is split into five subsections: Energy Efficiency, Renewable Energy, Transportation, Other Reduction Measures, and Outreach and Education; these subsections represent the major areas under which reduction measures can be effectively implemented. Most of the recommendations listed here focus on reducing emissions from the municipal sector, though some involve the entire community. These reduction measures provide a menu of options for reaching the 11% municipal reduction target and should be viewed as *potential* actions, many of which require more in depth feasibility studies. Some of the actions listed have already been implemented or are currently in progress, while others may not be possible at this time.

The actions listed here are meant to be implemented over time; some may be able to be done immediately, while it may take years before others can be implemented. The goal is to reach the municipal reduction target of a 11% reduction by 2010 and then to set a new emissions reduction target. Actions that the City can do easily and quickly, and actions that will require greater leadership, effort and time, can be equally important.

For each of the reduction measures, an associated amount of pollution prevented is reported. The pollutants that are reported are equivalent carbon dioxide (eCO_2), nitrous oxides (NO_x), sulfur oxides (SO_x), carbon monoxide (CO), volatile organic compounds (VOCs), and coarse particulate matter (PM_{10}). To learn where these pollutants come from and how they affect human health, see Table 1 on page 45.

For data sources and calculations behind the cost and pollution estimates of the reduction measures see Appendix E. For details on potential sources of funding, see Appendix F.

Health Effects Of Power Plant and Criteria Air Pollutants sources: Clear The Air and EPA.gov			
Pollutant	**What is it?**	**Health Effects**	**Most Vulnerable**
Nitrogen Oxides (NO_x)	A family of chemical compounds including nitrogen oxide and nitrogen dioxide. Nitrogen is naturally in coal.	NO_x decreases lung function and is associated with respiratory disease in children. Converts to ozone and acidic particles in the atmosphere.	Elderly, children, people with asthma.
Sulfur Dioxide (SO_2)	SO_2 is a highly corrosive, invisible gas. Sulfur occurs naturally in coal.	Coughing, wheezing, shortness of breath, nasal congestion and inflammation. Makes asthma worse. SO_2 gas can destabilize heart rhythms. Low birth weight, increased risk of infant death.	Children and adults with asthma or other respiratory disease.
Carbon Monoxide (CO)	CO is a colorless, odorless gas formed when the carbon in fuel is not burned completely. Most CO emissions come from on and off road vehicles.	Cardiovascular problems and chest pain. People who breathe high levels of CO can develop vision problems, reduced ability to work or learn, reduced manual dexterity, and difficulty performing complex tasks. At extremely high levels, CO is poisonous and can cause death. It also contributes to ground-level ozone, which can trigger serious respiratory problems.	Elderly, children, people with heart disease.
Volatile Organic Compounds (VOCs)	VOCs include many chemicals that come from a variety of household products and automotive fuel. VOCs are a major contributor to indoor air pollution.	Eye, nose, and throat irritation; headaches, loss of coordination, nausea; damage to liver, kidney, and central nervous system. Some VOCs can also cause cancer.	
Particulate Matter (PM)	A mixture of small solid particles (soot) and tiny sulfuric acid droplets. Small particles are complex and harmful mixtures of sulfur, nitrogen, carbon, acids, metals and airborne toxics.	PM crossing from the lung into the blood stream results in inflammation of the cardiac system, a root cause of cardiac disease including heart attack and stroke leading to premature death. PM exposure is also linked to low birth weight, premature birth, chronic airway obstruction and remodeling, and sudden infant death.	Elderly, children, people with asthma.
Carbon Dioxide (CO_2)	Coal has the highest carbon content of any fossil fuel.	Indirect health effects may be associated with climate change, including the spread of infectious disease, higher atmospheric ozone levels and increased heat and cold-related illnesses.	People of Color, children, people with asthma.
Ozone	Ozone is a highly corrosive, invisible gas. It is formed when NO_x reacts with other pollutants like VOCs in the presence of sunlight.	Rapid shallow breathing, airway irritation, coughing, wheezing, shortness of breath. Makes asthma worse. May be related to premature birth, cardiac birth defects, low birth weight and stunted lung growth.	Children, elderly, people with asthma or other respiratory disease. People who exercise outdoors.
Mercury	A metal that occurs naturally in coal.	Developmental effects in babies born to mothers who ate contaminated fish while pregnant. Poor performance on tests of the nervous system and learning. In adults may affect blood pressure regulation and heart rate.	Fetuses and children are directly at risk. Pregnant women, children and women of child-bearing age need to avoid exposure.

Table 1. *Health Effects of Criteria Air Pollutants*

Hire an Energy Manager

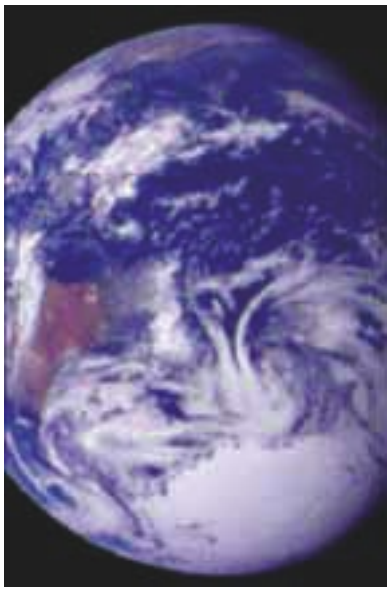
The most important reduction measure is to hire a full-time Energy Manager. This individual would be responsible for overseeing the implementation of the Plan, ensuring that proper plans are developed before implementing reduction measures, updating the emissions inventory, and writing progress reports. The Energy Manager would serve as a unifying entity among the fragmented municipal departments regarding energy use, planning, budgeting, supply, and load aggregation and would serve as a gatekeeper for all municipal energy use data. Without this position, the Action Plan's guiding force will be lost.

The Energy Manager can also serve to educate the community about Worcester's actions through maintaining the Energy Task Force web pages and may even expand the web pages to include information about all of the City's environmentally progressive initiatives, such as recycling, composting, elimination of mercury-containing products, and water conservation. Having information about all of Worcester's environmental initiatives in one place allows the City to more easily brand itself as a "green" city.

In addition, the Energy Manager can keep the City abreast of the latest energy policies, regional and national local government agreements, funding opportunities, actions of other communities, professional trainings, and media opportunities.

Implementation Cost:	$70,000/yr**	**Status:** proposed
Potential Cost Savings:	$1,111,564*	
Energy Saved (kWh):	3,291,340	**Equivalent to:** • A 140lb person climbing 8,919,531,400 stairs • The daily electricity use of 92,120 Americans
Tons of eCO_2 prevented:	346,989*	**Would fill:** 23,133,371,110 basketballs **Equivalent to driving:** 759,109,600 miles

*Represents the potential of the municipal reduction measures in the summary chart on pages 14 and 15 that the Energy Manager would assume responsibility for.
**Includes benefits.



3.1 Energy Efficiency

The design, construction, and maintenance of buildings have a tremendous impact on our environment and natural resources. There are more than 76 million residential buildings and nearly five million commercial buildings in the U.S. today. These buildings together use one-third of all the energy consumed in the U.S., and two-thirds of all electricity. By 2010, another 38 million buildings are expected to be constructed.[1] The challenge will be to build them so that they use a minimum of nonrenewable energy, produce a minimum of pollution, and cost a minimum of energy dollars, while increasing the comfort, health, and safety of the people who live and work in them.[2]

Traditionally constructed buildings consume more of our resources than necessary, negatively impact the environment, and generate a large amount of waste. The construction of a standard wood-framed home consumes over an acre of forest and creates an average of three to seven tons of waste. This type of building is also often costly to operate in terms of energy and water consumption.[3]

By being smarter about how we design and use buildings and devices and by taking advantage of technological innovations, we can use less energy to accomplish our tasks. In buildings, this means taking advantage of daylight to reduce artificial light, insulating while maintaining adequate indoor ventilation, and using other green building techniques. Appliances and other machines have become dramatically more energy efficient in recent decades Choosing products with energy in mind can reduce demand, particularly for electricity.[4]

In Worcester's municipal GHG emissions inventory, buildings account for 45% of the eCO_2 emissions. The only sector responsible for more GHG emissions is Waste, with 40% of emissions coming from the Greenwood Street Landfill and 7% coming from waste incinerated. Given that existing buildings consume the bulk of energy, retrofitting them with more efficient technologies should be a priority. Energy should be used to maximize the community's well-being, taking into consideration technological effectiveness, cost, and environmental impact.[5]

[1] The Mass Technology Collaborative (MTC) www.masstech.org Accessed 2005
[2] Amherst Climate Action Plan, September 2005
[3] Amherst Climate Action Plan, September 2005
[4] Cambridge Climate Protection Plan
[5] Amherst Climate Action Plan, September 2005

Existing Building Energy Upgrades

Implementation Cost:	$370,467	**Status:** Existing	
Annual Cost Savings:	$99,822	**Sector:** Municipal Buildings	
Payback Period:	3.7	**Measure Type:** Energy Efficiency	
Energy Saved (kWh):	767,863	**Equivalent to:** A 140lb person climbing 2,080,908,730 stairs The daily electricity use of 21,491 Americans	
Tons of eCO_2 prevented/yr:	285	**Would fill:** 19,006,335 basketballs **Equivalent to driving:** 623,496 miles	
lbs. of NO_x prevented/yr:	471	**lbs. of VOCs prevented/yr:**	108
lbs. of SO_x prevented/yr:	768	**lbs. of PM_{10} prevented/yr:**	718
lbs. of CO prevented/yr:	978		

Co-Benefits:

- Cost savings from reduced energy use.
- Reduce electrical demand in the region.

Description:

The City of Worcester has taken advantage of various energy efficiency upgrades through partnership with National Grid.[1] National Grid, the city's electric provider, offers a host of rebates to motivate commercial, residential, and government customers to increase their energy efficiency. Since 2002, the City has implemented upgrades in HVAC, lighting, and other energy consuming appliances throughout Worcester's schools, Fire Department, the DCU Center (formerly the Centrum), and the Department of Health. These actions have resulted in an annual cost savings of $99,822 and the prevention of 285 tons of greenhouse gases (aka eCO_2) each year.

The City should continue working with National Grid to conduct building energy audits and efficiency upgrades. However, there is currently no organized system for determining which buildings should be audited and which upgrades the City should invest in. There is also no database of the efficiency actions that the City has already taken. To rectify this situation, the ETF suggests developing an Energy Management System as described in the following measure.

[1] The City has also worked, although on a smaller scale, with Worcester's gas utility, NSTAR. NSTAR upgrades are not included in this analysis because of a lack of communication w/ NSTAR. The ETF hopes that NSTAR can be more involved in future energy analysis and planning and encourages NSTAR efficiency upgrades to also continue.

Develop an Energy Management System Using Energy Star's Portfolio Manager

Implementation Cost: To be determined
Annual Cost Savings: Variable
Payback Period: Variable

Status: Proposed
Sector: Municipal Buildings
Measure Type: Energy Efficiency

Co-Benefits:

- Reduction of particulate matter, NO_X, SO_X, mercury and other harmful air pollutants.
- Long-term savings to the city from avoided fuel and operational costs;
- Reduced municipal susceptibility to the negative impacts of fuel price spikes.

Success Stories:

The City of Toledo, OH undertook comprehensive retrofits of 20 City buildings and facilities. Energy-saving measures in Toledo's program included installing energy efficient lighting and motion sensors and replacing window air conditioners with digitally controlled boilers and chillers. In the first year, electricity use was cut by 5,823,000 kWh and the upgrades resulted in financial savings of $710,208.[1]

Description:[2]

In order to keep track of the energy audits performed and efficiency actions taken, it is necessary to implement some type of organized data compilation and building inventory system. The ETF suggests using EPA's national energy and water consumption rating system called Portfolio Manager. This system allows the City to measure the energy efficiency of municipal buildings and compare them to others across the United States. Using data the City provides online, the system produces a baseline rating from 1 to 100. Once the City has established this baseline, Energy Star's tools and resources can be used to prioritize investments, set goals, and track consumption and management success.

Energy Management Funds: Duluth, Minnesota officials set up an Energy Management Fund to capture operating cost savings and utility rebates to fund future public energy projects.

Energy and resource efficiency upgrades should be implemented in order to reduce consumption of fossil fuels (such as heating oil and natural gas), electricity, and water. Retrofits include upgrades of HVAC systems, lighting systems, boilers, and chillers; other examples are the installation of low-flow faucet fixtures, replacement of incandescent exit sign lights with LED's, and occupancy sensors. Measures that pay for themselves in a relatively short time - such as one to five years - should be implemented as soon as possible. Other priority retrofits, offering a longer horizon for returns on investment, should be considered once a building inventory and cost/benefit analysis have been completed for each building.

The goal of the cost/benefit analysis is to determine the priority of city building retrofits and to begin capital planning for retrofits that are necessary but that may have longer payback periods. The ETF suggests that the City make use of energy auditing services provided by National Grid and NSTAR in order to obtain clear estimates of the capital costs and operational savings of retrofits. It is important that an energy audit address all facets of resource use within a building. That is, an energy audit should address electricity, thermal energy, and water consumption within each facility and not focus narrowly on one area such as electricity. With the information provided by a complete energy audit,

the Energy Manager and/or other appropriate officials can prepare the cost/benefit analysis with assistance from key municipal departments.

The cost/benefit analysis should contain:

- a list of recommended retrofits for each building, including projected capital costs and life-cycle cost savings for each retrofit;
- recommended priorities for retrofits based on energy savings, capital costs, and life-cycle cost savings;
- comprehensive research on utility, state, or federal programs which may offer cost-sharing or grants for retrofits.

Co-Benefits

Besides cost savings and pollution prevention, using Energy Star's Portfolio Manager will allow Worcester the opportunity for free publicity on high-scoring buildings and on energy reduction upgrades.

Potential Sources of Funding:

- National Grid
- NSTAR
- ESCOs

Next Steps:

- **Input buildings data into Energy Star's Portfolio Manager online.**
- **Work with National Grid to set up Energy Audits and to document upgrade recommendations.**
- **Prioritize upgrades based on capital costs, cost savings, and energy/resource savings.**
- **Determine the amount of funding available to invest in energy efficiency projects**
- **Implement upgrades, documenting completed actions, and continue to track buildings energy and water consumption as well as energy audits and upgrade history.**

Resources

- **http://www.caleep.com/workbook/workbook.htm**
- **EPA's Energy Performance Rating System** http://www.energystar.gov/index.cfm?c=evaluate_performance.bus_portfoliomanager

Success Story:[3]

Phoenix, Arizona

Phoenix began an energy management program in the late 1970s with no project funds the first year. The program developed slowly. At first, the city focused on projects with low costs, such as installing inexpensive controls on equipment in buildings. The city also carried out energy audits of more than 150 city facilities and, in 1978, hired a professional energy manager.

The new manager quickly established credibility with the city council by documenting savings of more than $150,000 during the following year. In 1980, the city council invested $50,000 to carry out the recommendations of the city's energy audits. Funds from energy savings were left in the general fund account.

Then in 1984, the mayor and the city council established the Energy Conservation Savings Reinvestment Plan. Under this plan, the city reinvests 50% of all documented energy savings, up to a limit of $500,000, to finance energy efficiency capital projects for the following year.

Some "seed" money was provided in the early years of the plan. By 1986, energy savings exceeded $1 million per year and the fund reached its limit of $500,000, where it continues to the present. The fund is used to help departments purchase new energy-conserving capital equipment.

For example, if a department needs to buy new energy-consuming equipment, such as a chiller for air conditioning, the fund can pay for the difference between an energy-efficient model and a cheaper model that is less energy efficient.

Phoenix's experience with budget incentives can probably be repeated with other local governments. The first step is to develop accounting and energy planning and monitoring capabilities in house. With this in place, one can verify the results and take advantage of the long-term financial benefits of effective energy management.

[1] Brookline Climate Action Plan, 2002.
[2] Some wording for this section borrowed from Somerville's Climate Action Plan
[3] Somerville Climate Action Plan

Upgrade Red Traffic Lights to LEDs

Implementation Cost:	$70,713 (after $200,000 NGrid rebate)	**Status:** Existing	
Annual Cost Savings:	$80,000	**Sector:** Municipal Lighting	
Payback Period:	less than 1 yr	**Measure Type:** Energy Efficiency	
Energy Saved (kWh):	472,164	**Equivalent to:** A 140lb person climbing 1,279,564,440 stairs The daily electricity use of 13,215 Americans	
Tons of eCO_2 prevented/yr:	175	**Would fill:** 11,670,557 basketballs **Equivalent to driving:** 382848 miles	
lbs. of NO_x prevented/yr:	290	**lbs. of VOCs prevented/yr:**	66
lbs. of SO_x prevented/yr:	472	**lbs. of PM_{10} prevented/yr:**	441
lbs. of CO prevented/yr:	601		

Co-Benefits:

- Cost Savings from reduced energy use and reduced maintenance costs.
- Safer traffic lights.
- Visible energy saving / pollution prevention action.

Description:

In 1997, all 1,200 red traffic lights in the City of Worcester were converted from energy-intensive incandescent bulbs to the highly efficient light emitting diodes (LEDs). Before this city-wide conversion, a test case was carried out that entailed all nine of the red lights at one intersection being converted. This resulted in an 84% reduction in watts per bulb and a 58% reduction in total energy cost. Early in 2000, the city began retrofitting the green lights as well as the pedestrian walk/don't walk signals (peds). To date, approximately 25% of these have been converted, continually saving the city energy and money.[1] The cost of the retrofit is miniscule in comparison to the savings, and National Grid offers rebates for the conversions. Besides using much less energy, LEDs need less maintenance due to longer life. They are also safer since they are made up of many dots of light and so do not completely burn out like the incandescent bulbs. Typically clusters of lighted dots will burn out together, leaving the rest of the signal lighted.

[1] There is conflicting information regarding the conversion of green lights in the city. There may be a higher percentage of green lights converted. If all of the green lights are not converted, the City should implement this energy and cost saving measure immediately. Rebates are available from National Grid. The City should also convert all pedestrian lights as soon as possible. A custom rebate can be arranged with National Grid for the pedestrian lights.

Upgrade 200 Exit Signs from Incandescent Lights to LEDs

Implementation Cost:	$3,000	**Status:** Proposed	
Annual Cost Savings:	$7,972	**Sector:** Municipal Lighting	
Payback Period:	under 5 months	**Measure Type:** Energy Efficiency	
Energy Saved (kWh):	61,320	**Equivalent to:** A 140lb person climbing 166,177,200 stairs The daily electricity use of 1,716 Americans	
Tons of eCO_2 prevented/yr:	23	**Would fill:** 1533845 basketballs **Equivalent to driving:** 50,317 miles	
lbs. of NO_x prevented/yr:	38	**lbs. of VOCs prevented/yr:**	9
lbs. of SO_x prevented/yr:	61	**lbs. of PM_{10} prevented/yr:**	57
lbs. of CO prevented/yr:	78		

Co-Benefits:

- Reduced mercury emissions.
- Cost savings from reduced electricity consumption and maintenance.

Success Stories:

The City of Overland Park, KS changed from incandescent lights to LED exit signs in all public buildings. The project saves the City 41,000 kwh of electricity and $2,750 annually. This measure resulted in a CO_2 reduction of 35 tons.[1]

Description:

Upgrading incandescent lighted exit signs to LED lights can drastically reduce the energy used and the associated costs. LEDs can last up to 10 times longer than incandescent lights, thus also reducing the maintenance costs. In the above calculations, 200 exit signs are converted from incandescents to LEDs. The cost of this retrofit is approximately $15 per sign: $25 per fixture, $10 installation, $20 rebate from National Grid. With such a short payback period, all of the City's exit signs should be upgraded as soon as possible and any new signs installed should be lighted by LEDs or a more efficient technology.

LEDs are also more efficient than fluorescent lights. If any of the City's exit signs are fluorescent, they may also be upgraded to save energy and money. Furthermore, the fluorescent lamps in one exit sign can contain more than 10 mg of mercury.[2] Thus, by switching to LEDs, a facility with 20 fluorescent exit signs can reduce mercury use over a 10-year period from more than 750 mg to zero and mercury emissions related to power use from 450 mg to 30 mg. Upgrading from incandescent lighting will also reduce mercury emissions from electricity generation, as LEDs use about 1/10 of the energy. 750 mg of mercury can contaminate over 1,000 fish to the point where they cannot be eaten.[3]

Upgrade 200 Exit Signs from Incandescent Lights to LEDs

Potential Sources of Funding:

- National Grid

Next Steps:

- Determine the number of municipal exit signs and current lighting type of each sign.
- Work with NGrid to retrofit all incandescent signs and to determine the cost effectiveness of upgrading other types of exit sign lights (i.e. fluorescents).
- Implement a policy to ensure that future municipal exit signs are the most efficient lighting available.

[1] Brookline Climate Action Plan, 2002.

[2] New Jersey Purchase Bureau, "Lamps, Incandescent, HID, Fluorescent, Including Low Mercury," Notice of Award T-0192, August 1, 2003, http://www.state.nj.us/treasury/purchase/noa/contracts/t0192.shtml.

[3] Assuming a 3 pound fish and a consumption advisory level of 0.5 parts per million mercury.

Increase the Efficiency of Lighting in the Pearl/Elm Garage

Implementation Cost: $44,280
Annual Cost Savings: $31,387
Payback Period: 1.4 years

Status: Proposed
Sector: Municipal Lighting
Measure Type: Energy Efficiency

Energy Saved (kWh): 241,440

Equivalent to:
A 140lb person climbing 654,302,400 stairs
The daily electricity use of 6,758 Americans

Tons of eCO_2 prevented/yr: 89

Would fill: 5,933,531 basketballs
Equivalent to driving: 194,706 miles

lbs. of NO_x prevented/yr: 148
lbs. of SO_x prevented/yr: 242
lbs. of CO prevented/yr: 307

lbs. of VOCs prevented/yr: 34
lbs. of PM_{10} prevented/yr: 226

Co-Benefits:
- Better light quality.
- Reduced light pollution.

Success Stories:
Harvard Medical School upgraded the parking garage interior lighting system, consisting of HPS lighting systems and some lighting fixtures with T-12 lamps powered by magnetic ballasts that were left on 24/7. The system was upgraded with long-life T-8 lamps powered with electronic ballasts, and automatic lighting controls. This resulted in savings of $18,872.55 (a 59% reduction in annual electric operating cost) and 268,871 lbs of CO_2. The resulting electric load reduction was 17.23 KW, annual kWh savings of 163,824 kWh. A total of 228 fixtures were upgraded or replaced and 19 automatic lighting controls were installed. The payback was 2.3 years.[1]

Description:
Parking garages can be highly energy intensive because of their large area and the need to be lighted for many hours a day, if not constantly. The ETF suggests upgrading from metal halide lighting to high-efficient T-5 or T-8 fluorescent lighting in the Pearl/Elm municipal parking garage. These lights use 35%-50% fewer watts and NGrid pays about half of the total cost through fixture rebates. The amount of hours per day that the lights are operating should also be assessed, as well as the possibility of installing light and motion sensors.

Potential Sources of Funding:
- National Grid
- ESCOs

Next Steps:
- Have NGrid conduct an energy audit and efficiency assessment of the Pearl/Elm Garage.
- Implement NGrid's lighting energy efficiency recommendations.

[1] www.greencampus.harvard.edu

Change-A-Light Campaign: Each Household Changes One Incandescent Bulb to a CFL

Implementation Cost:	$190,527 ($3/home)	**Status:** Proposed	
Annual Cost Savings:	$1,042,376 ($16.41/ home)	**Sector:** Residential	
Payback Period:	.2 years	**Measure Type:** Energy Efficiency	
Energy Saved (kWh):	6,541,427	**Equivalent to:** A 140lb person climbing 53,549,600 stairs The daily electricity use of 553 Americans	
Tons of eCO_2 prevented/yr:	2,424	**Would fill:** 161,653,884 basketballs **Equivalent to driving:** 5,302,997 miles	
lbs. of NO_x prevented/yr:	4,015	**lbs. of VOCs prevented/yr:**	921
lbs. of SO_x prevented/yr:	6,546	**lbs. of PM_{10} prevented/yr:**	6,113
lbs. of CO prevented/yr:	8,330		

Co-Benefits:

- Increase community and personal awareness of energy use and its effects.
- CFL Light bulbs last longer than conventional bulbs, saves time and money spent replacing burnt-out bulbs
- Compact fluorescents operate at a lower temperature than incandescent bulbs, safer and can help to lower cooling costs.

Next Steps:

- Determine the time line, goals, and partners in the Change-A-Light educational campaign.
- Seek out necessary funding.
- Implement the campaign and save energy.

Description:

Annual residential energy use has been steadily increasing (see Section 2) in Worcester. If every household in the city changed just one incandescent bulb to a compact fluorescent (CFL) bulb, the energy, cost, and GHG emission savings would be substantial. Annually 2,424 tons of eCO_2 would be prevented and $1,042,376 (or $16.41/ home) saved - and that's just from changing one light bulb! Typically, the cost of a CFL is around $3.50 - 7 times more expensive than a $0.50 incandescent bulb. However, CFLs last 10 times longer than incandescents and thus actually end up being cheaper in the long run. The majority of cost savings, though, comes from the reduction of energy used by the CFL, using just 1/7 of the kilowatt hours of a traditional incandescent bulb. Additionally, CFL bulbs are available at Spags 19 on the Boston Turnpike in Worcester for $0.50 / each (February 2006) and various types of CFL bulbs are available at reduced prices on bulbs.com, an online lighting sales and recycling company based in Worcester. The CIty could partner with these venders to advertise their bargain prices.

The City should implement a residential Change-A-Light informational campaign to encourage residents to use CFL bulbs. Because the economic reasons for switching are so strong, it is a matter of getting the information

out as well as presenting residents with the opportunity to make the purchase. The City may consider selling CFLs directly to the public through a partnership with a reseller (or resellers). Perhaps purchasing in bulk would allow for a discounted price. It will also be easier to track progress if the City is giving out the bulbs directly. Bulbs could be for sale at City Hall and through partner organizations throughout the City, such as the Regional Environmental Council, public library, grocery stores and various restaurants. The City may even consider giving away a portion of the bulbs as a promotion in the beginning. Campaign ideas and lessons learned can be gathered from other cities that have implemented similar campaigns.

Potential Sources of Funding:

- National Grid (Resources)
- North Eastern Grassroots Environmental Foundation (NEGEF)
- EPA
- Other potential funding sources may include: manufacturers of CFLs, local business sponsors, and national businesses with local stores that sell light bulbs, including Home Depot, Target, Spags / Building 19, and bulbs.com.
- Potential advertising donors include the Telegram & Gazette, Worcester Magazine, and local TV and Radio stations.

Residential Energy Efficiency

There are many other actions residents can take to make their homes more energy efficient, saving money and preventing greenhouse gas emission at the same time. As shown in Figure 20, most of the energy used in residences goes towards temperature control. Based on this, the most important things a resident can do is to purchase Energy Star air conditioners and heating equipment, as well as properly insulate his/her home and install energy efficient windows. Energy Star is an efficiency rating system created by the U.S. EPA to highlight the most energy efficient appliances available. Energy audits are available for free from Worcester's electric utility, National Grid, for all residential customers. The following table outlines key ways a resident may reduce energy use, including the estimated amounts of dollars saved and emissions prevented.

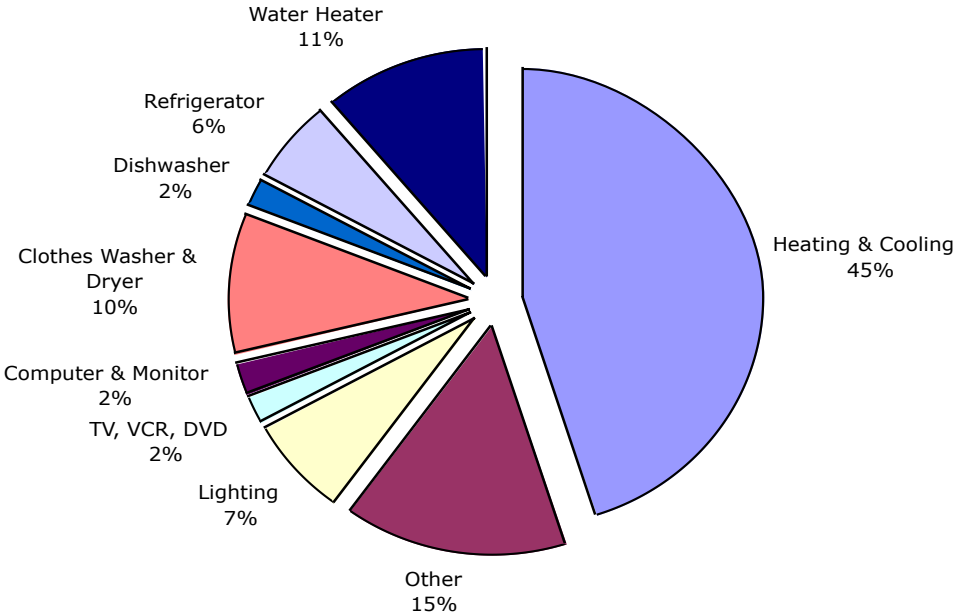


Figure 20. *Average Household Energy Use (U.S. National Average)*

"Other" represents an array of household products, including stoves, ovens, microwaves, and small appliances. Individually, these products account for no more than about 2% of a household's energy bills. Source: energystar.gov

Specific Action	Annual Household Cost Savings	Annual Household eCO_2 Reductions	Assumptions
Heating/Cooling			
Install Energy Star heating equipment during new construction.	$85	1,400 lbs	Assumes natural gas, annual CO_2 emissions of 9465 lbs and energy costs of $566. Energy Star equipment can save up to 15% in energy bills.
Properly insulate and define building shell, minimize air leakage (esp. at top and bottom of heated envelope).	$50-$100	1,900 lbs	Assumes natural gas, annual CO_2 emissions of 9465 lbs and energy costs of $566. Energy Star equipment can save up to 15% in energy bills.
Select low carbon content heating fuel such as natural gas.		4,600 lbs	Assumes 80.9 mmbtu consumption for annual space heating. Oil emissions = 173.9 lbs CO2/mmbtu, natural gas emissions = 117 lbs CO2/mmbtu.
Install programmable thermostat to set back temperatures at night.	$60	1,170 lbs	Assumes annual conservation of 10 mmbtu and cost of $0.62/ccf.
Install Energy Star windows.	$80	1,400 lbs	Savings are site-specific.
Install Energy Star window air conditioning units if necessary.	$50	330 lbs	Assumes annual consumption for New England home = 738 kWh, Energy Star unit saves 30%. 1.481 lbs CO2/kWh.
Appliances/Electronics			
Purchase Energy Star TVs, VCRs, and other home electronics.	$8	110 lbs	Assumes TV off for 18 hrs/day; conventional TV uses 13W when off, Energy Star TV uses only 1.5W when off.
Purchase a high versus standard efficiency water heater. Select gas water heaters instead of electric.	$565	2,800 lbs	Assumes selecting natural gas water heater over electric; 19.5 mmbtu annual consumption for hot water. Electric rate of emission = 0.885 lbs COs/kWh, cost = $0.10/kWh. Natural gas = 117 lbs CO2/mmbtu, cost = $0.62/ccf. Typical family of four
Use less hot water. Install non-aerating low-flow shower heads.	$120	1,800 lbs	Assumes natural gas heated water
Purchase Energy Star refrigerators.	$60 (compared to 1993 models) $19 (compared to models meeting federal minimum efficiency standards)	1,000 lbs (compared to 1993 models) 285 lbs (compared to models meeting federal minimum efficiency standards)	Assumes 1,200 kWh for pre-1993 model, 575 for Energy Star model. **Based on Ammana BH20S5, 575 annual kWh, 768 NAECA consumption.
Unplug second refrigerator/freezer.	$100 (more on older models)	1 (more on older models)	Assumes year-round operation on 2ndrefrigerator; 1,200 kWh consumption.
Purchase Energy Star clothes washers and dryers.	$58 (electric powered machines) $20 (natural gas powered machines)	860 lbs (electric powered machines) 280 lbs (natural gas powered machines)	
Line dry laundry.	$0.35 per load of laundry	5 lbs per load of laundry	
Purchase Energy Star dishwashers.	$28 $20 (compared to models meeting federal minimum efficiency standards)	410 lbs 260 lbs (compared to models meeting federal minimum efficiency standards)	Assumes existing consumption = 800 kWh/yr, new = 700 kWh/yr. **Energy Star dishwasher is 33% better than latest standards.

Table 2. *Residential Energy Efficiency Options*

Municipal Energy Efficiency Purchasing Policy

The adoption and implementation of a municipal green (environmentallyfriendly and/or energy efficient) procurement policy will ensure that newly purchased items have the greatest energy efficiency for their intended use. A procurement policy that commits the City to energy efficiency will produce important environmental and economic benefits and should be adopted immediately. A draft policy, based on the City of Medford's Energy and Resource Policy, can be found in Appendix A.

An Energy Efficient Purchasing Policy means that energy will be considered in all municipal purchases where appropriate. In practice, it means purchasing energy star computers, air conditioners, televisions, referigerators and other appliances, as well as efficient lighting equipment and control systems such as motion sensors. These purchases wil reduce GHG emissions, criteria air pollutants, and operating expenses. The purchase of efficient vehicles is discussed in the Transportation Section, 3.3, and the purchase of recycled content products is discussed in the Waste Section, 3.4.1. Municipal departments can also practice bulk purchasing of energy efficient and recycled content products to reduce the intial costs of these products. Departments can group their needs or can join onto state contracts. The City may also consider including environmentally friendly considerations in this purchasing policy to reduce the use of toxics as Santa Monica, CA has (see side bar). The Environmentally Preferable Purchasing Program (EPP) can serve as a resource and a potential way of purchasing in bulk with other communities.

Success Stories

Santa Monica, CA developed an Environmentally Preferable Purchasing Program in 1991. Benefits of the program include: 5% reduction in spending on custodial supplies by replacing 15 products with less toxic or non-toxic alternatives, switching to an integrated pest management program that cost up to 30% less than traditional pest application used before, using rerefined motor oil that cost the City 25% less than virgin motor oil.[1]

A green procurement policy makes the City's support of environmentally sustainable practices explicit by requiring that every municipal purchase be made with energy efficiency in mind. This recommendation benefits the Worcester community not only because of the overall impact on the environment but also because of the cost savings over time. The lifecycle cost (i.e. total cost of an item over the time period of its use) of an efficient item can be significantly less than that of an inefficient item.

Potential Sources of Funding

- City budget (life-cycle costs for energy-efficient items will be cheaper and cost the City less money over time)
- ESCOs for certain large applications
- National Grid

Resources

Environmentally Preferable Purchasing Program (http://www.epa.gov/epp/)

Experts estimate that by using ENERGY STAR® qualified products, a typical household can cut its utility bills by 30%. If all US appliances were Energy Star, the reduction in greenhouse gas emissions would be equivalent to taking 14.5million cars off the road each year. The national annual energy bill would be reduced by about $100 billion over the next decade.[1]

[1] Newton Climate Action Plan, February 2005.

Municipal Green Building Policy

Green building means building in a way that reduces energy use, water consumption, sprawl, and indoor air pollutants. In this day and age, it would be foolish not to consider efficiency and environmental issues when it can significantly reduce operating costs and pollution and typically add very little cost onto the construction. A municipal Green Building Policy means that the all new municipal buildings and major renovations would be required to meet LEED Silver standards unless the DPW & P, Architectural Services Division first makes a finding and reports to the City Manager that such certification is not in keeping with the use or purpose of the building or is otherwise inappropriate. LEED stands for Leadership in Energy and Environmental Design. LEED is a voluntary rating system based on well-founded scientific standards, and it has quickly become the national standard for green building in the United States. A draft Green Building Policy, based on the City of Arlington's policy, can be found in Appendix A.

This lightshelf is part of the energy efficient design at the new Capuano School, the first Leadership in Energy and Environmental Design (LEED) registered public school in New England. (Somerville CAP, 2003)

Community-Wide Green Building Policies from Neighboring Cities and Towns:

- Brookline, MA has suggested developing its own green building code with incentives that would enhance the State requirements. Based on estimated savings from other municipal green building codes, this measure could result in the elimination of 25,624 tons of CO2 and financial savings of $2,137,974 for citizens who choose to make energy efficiency upgrades in their buildings.[1]
- The City of Cambridge revised its zoning laws to request that private developers address environmental aspects of the LEED standards when applying to the Planning Board for a permit.[2]
- Somerville, MA is also encouraging green building throughout the entire community. The Somerville CAP states: Project managers will be encouraged to adopt "green building" practices for new construction and during renovation of existing commercial and industrial buildings through an incentive-based zoning and permitting process that will be implemented by 2004. At least 10% of new buildings or renovations should follow recommended practices by 2007 and 20% by 2010.

  The steps toward this goal include:
- Requiring project managers for all new or renovated commercial and industrial

■ *The LEED™ Green Building Rating System*

The Leadership in Energy and Environmental Design (LEED™) Green Building Rating System is the most widely used and accepted standard for green building in the United States. It was developed by the U.S. Green Building Council, a national nonprofit coalition representing all segments of the building industry. In addition to serving as a national standard, LEED is a certification tool. Points are awarded for design and construction practices and technologies in six categories: sustainable sites, water efficiency, energy and atmosphere, materials and resources, indoor environmental quality, and innovation and design. By accumulating points, a building can achieve a rating of LEED Certified, Silver, Gold or Platinum.

To learn more about LEED, visit www.leedbuilding.org.

From Chicago's Green Build Agenda

buildings in Somerville to fill out a Leadership in Energy and Environmental Design (LEED) rating score sheet, regardless of their intention to obtain a LEED rating.

- Providing builders and designers with information on green building practices and green building consultants in the area who can assist in filling out the LEED score sheet.
- Strongly recommending that all new or renovated commercial and industrial large development projects (over 50,000 square feet) in Somerville meet a LEED silver rating and have a minimum of three points in the energy section.
- Giving permitting priority and reducing permit processing time for buildings that meet or exceed a LEED silver rating and have a minimum of three points in the energy section.
- Giving special consideration for variances in zoning requirements (i.e. building density, green space, parking), within the limits of the planning board's powers, to buildings that meet or exceed a LEED silver.

[1] Brookline Climate Action Plan, 2002
[2] Newton Climate Action Plan, February 2005
[3] Somerville Climate Action Plan

3.2 Renewable Energy

Conventional electricity use and production in Massachusetts has a high impact on climate change. Roughly one-third of all CO_2 emissions are produced as a by-product of electricity generation. Efficiency measures are important, as they will reduce the City's energy demand, but supporting clean, renewable sources of energy is equally important. People will always need energy and, even with efficiency measures, energy demand will most likely continue to grow. To be able to provide the needed electricity and energy, we must look to clean, renewable sources.

Renewable energy sources will always be able to provide us with the energy we need as long as they are properly managed. They will not degrade our environment or harm our health, and they will lessen our dependence on foreign sources of oil. Renewable energy can be generated on a smaller scale than traditional energy sources, thus allowing energy production closer to home and increasing the reliability of our electricity system and the number of good, local jobs. One of the largest solar equipment manufacturers, Evergreen Solar, is right here in Marlborough, MA. Renewable energy plays a key role in creating a sustainable energy future.

Solar air heating has the best financial payback of the renewable energy technologies. Even with state and federal rebate programs, solar air heating pays for itself faster than PV or wind[2].

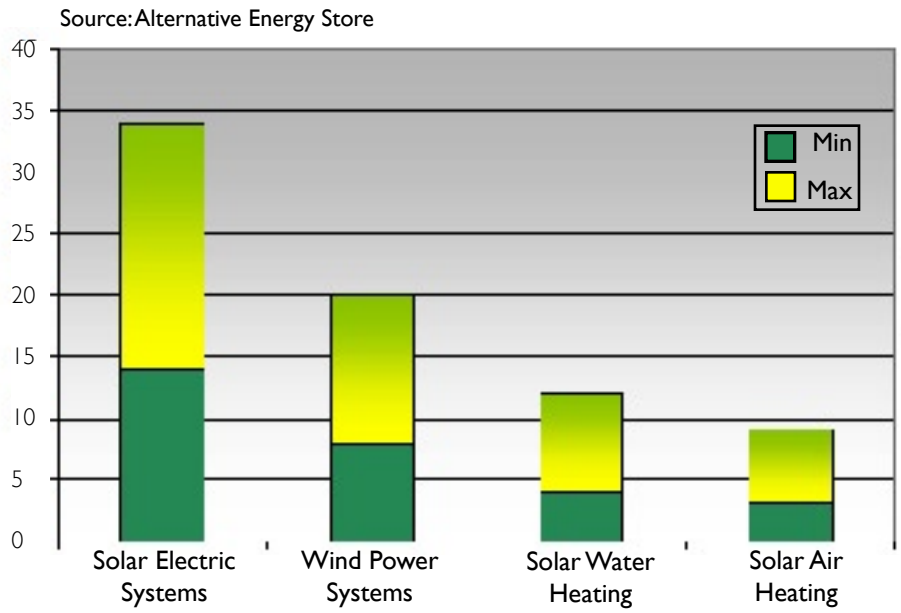


Figure 21. *Payback Period on Different Renewable Energy Technologies without Financial Incentives*

The City of Worcester has passed a Clean Energy Resolution stating that 20% of the ***electricity*** used by the municipality will be purchased from clean, renewable sources of ***electricity*** by 2010. This resolution was passed in March 2005 by a unanimous vote of the City Council. Thirty-five supporters of the resolution attended the council meeting. Part of the purpose of this Climate Action Plan is to recommend actions that can help the City can reach this clean electricity goal.

Solar Efficiencies:
source: Alternative Energy Store

Electricity (PV):	16%
Air Heating:	55%-75%
Water Heating::	85%

Clean Energy is:

- **Natural – powered by the sun, wind, and water, the heat in the ground, and crop and wood waste**
- **Energy that does not contribute to global warming or air pollution**
- **Locally produced, so it can promote energy security and local job growth**
- **Renewable - constantly replenishing itself in supply and strength**
- **Powerful, with tremendous potential. There is already enough clean energy to power every home in New England! (US Dept. of Energy)**

Fuel Cells produce electricity directly from the electrochemical reaction between hydrogen and oxygen, producing water and heat as byproducts. This technology is only "clean" if the process used to produce the hydrogen gas is powered by a clean source of energy.

Biomass facilities are "clean" if plant matter (biomass) is harvested and decomposed in a way that does not deplete resources or cause a net increase of CO_2 in the atmosphere. Breaking down biomass releases energy the plant stored from the sun.

Geothermal energy uses steam and hot water from inside the earth.

Which technologies are considered "clean"?

Solar power captures the light and heat of the sun to generate electricity and store thermal energy.

Wind energy converts the mechanical energy of air in motion into electricity through the use of turbines.

Small or low-impact hydroelectric power stations harness the energy of falling water. To minimize environmental impact, stations should be 30MW or less in size or meet standards set by the Low Impact Hydropower Institute.

Landfill Gas can be collected from decomposing organic material in landfills and combusted to produce energy. Trapping landfill gas prevents methane and other greenhouse gases from contributing to global warming.

Nuclear power is NOT considered a clean, renewable resource by environmental organizations, the state Renewable Portfolio Standard (see page 63), or the Mass Technology Collaborative. Though nuclear does not give off the typical air pollution emissions, it produces radioactive material and a host of issues associated with radiation. It is also not renewable.

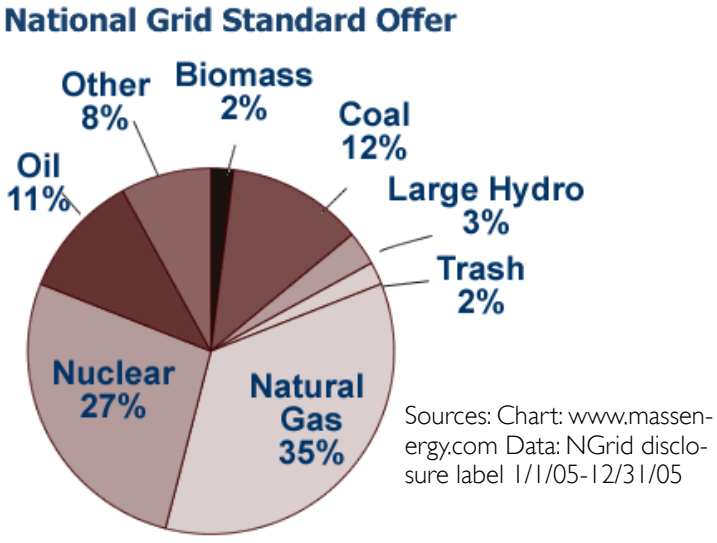


Figure 22. *Electricity Sources for National Grid's Standard Offer*

Promote Clean Energy Choice®

Implementation Cost: To be determined
Annual Cost Savings: $324,124
Payback Period: To be determined

Status: Proposed
Sector: Residential Electricity
Measure Type: Renewable Energy

Tons of eCO_2 prevented/yr: 16,455

Would fill: 1,097,365,789 basketballs

Equivalent to driving: 35,998,687 miles

lbs. of NO_x prevented/yr: 27,250

lbs. of VOCs prevented/yr: 6,253

lbs. of SO_x prevented/yr: 44,430

lbs. of PM_{10} prevented/yr: 41,495

lbs. of CO prevented/yr: 56,543

Co-Benefits:

- Provides funding for municipal clean energy projects.
- Educates the community about renewable energy.
- Shows the City's dedication to renewable energy and the future of its residents.

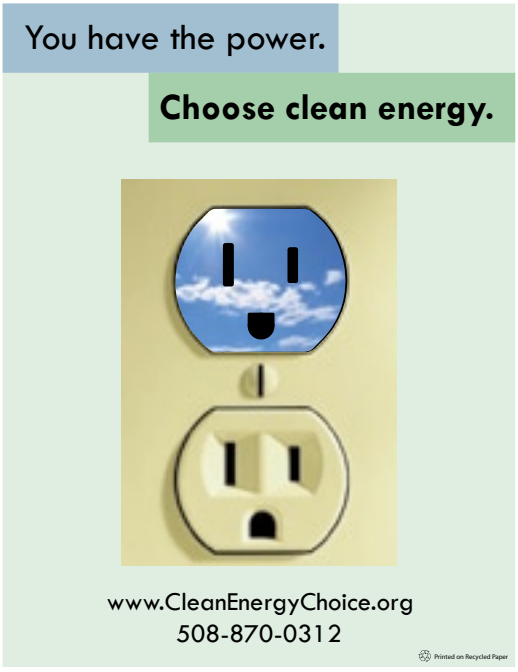
Success Stories:

- Northhampton, Williamstown, New Salem, Petersburg, and several towns and cities on Cape Cod have at least 3% of their population signed up for Clean Energy Choice®, making them eligible for further funding from MTC.

Description:

What is Clean Energy Choice®?

To understand the **Clean Energy Choice®** program, we must first understand the **GreenUp℠** program. Worcester's electric utility, National Grid, offers customers the option of supporting renewable electricity by paying a few extra dollars on their electric bills each month. This program is called GreenUp℠. There are currently four renewable electricity suppliers participating in the GreenUp℠ program. Each supplier differs in product offered, cost, and incentives. Customers choose which supplier they would like to support and they pay an additional price each month. Customers can also choose to pay on half of their electricity use or all of their electricity use. The product the customer is buying is the renewable attributes that are generated when electricity from a renewable source is generated. These attributes are typically called **Renewable Energy Credits** or RECs. See Figures 23 and 24.



Clean Energy Choice® is a program of the Massachusetts Technology Collaborative (MTC). This program supports all four of the GreenUp℠ suppliers by matching up to 100% of customers' premiums and putting this money into a Clean Energy Fund for Worcester. MTC also doubles their match, putting an equal amount of money into a Low-Income Fund to support clean energy projects in low-income areas of Massachusetts. For example, a customer pays $5.00 extra on their electric bill to support renewable electricity. MTC puts up to $5.00 into Worcester's Clean Energy Fund and up to $5.00 into the MA Low-Income Clean Energy Fund. The percentage that MTC matches is determined by the product of the supplier. See Table 3 on the following page for more details. Currently, the City has over $22,500 in its Clean Energy Fund after using $24,000 to fund the Energy Consultant and Energy Task Force to create this Climate Action Plan (CAP).

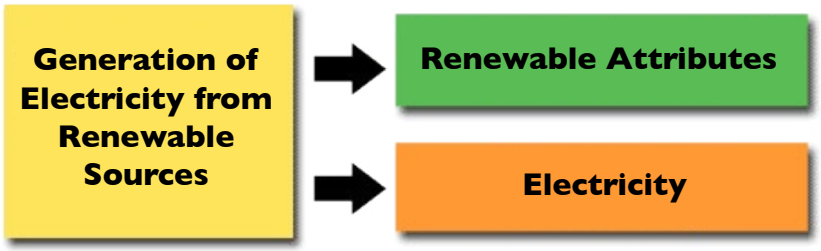


Figure 23. *Renewable Energy Certificate Generation*

Figure 24 below shows the flow of electricity, money, and renewable attributes (aka RECs). Electricity is generated from various sources, clean and dirty, and input into the New England power grid. In the figure below, renewable energy certificates are generated from the wind generator and sold to a broker. The brokers in Worcester's case are the four renewable electricity suppliers in the GreenUp℠ program. The customer receives electricity from the New England Power Grid, which is transmitted by the utility (in Worcester's case this is National Grid) and renewable energy certificates from the GreenUp℠ supplier of choice. The customer pays National Grid for both the electricity and the RECs through his/her monthly electric bill. National Grid then transfers the REC portion of the customer's payment to the appropriate GreenUp℠ supplier.

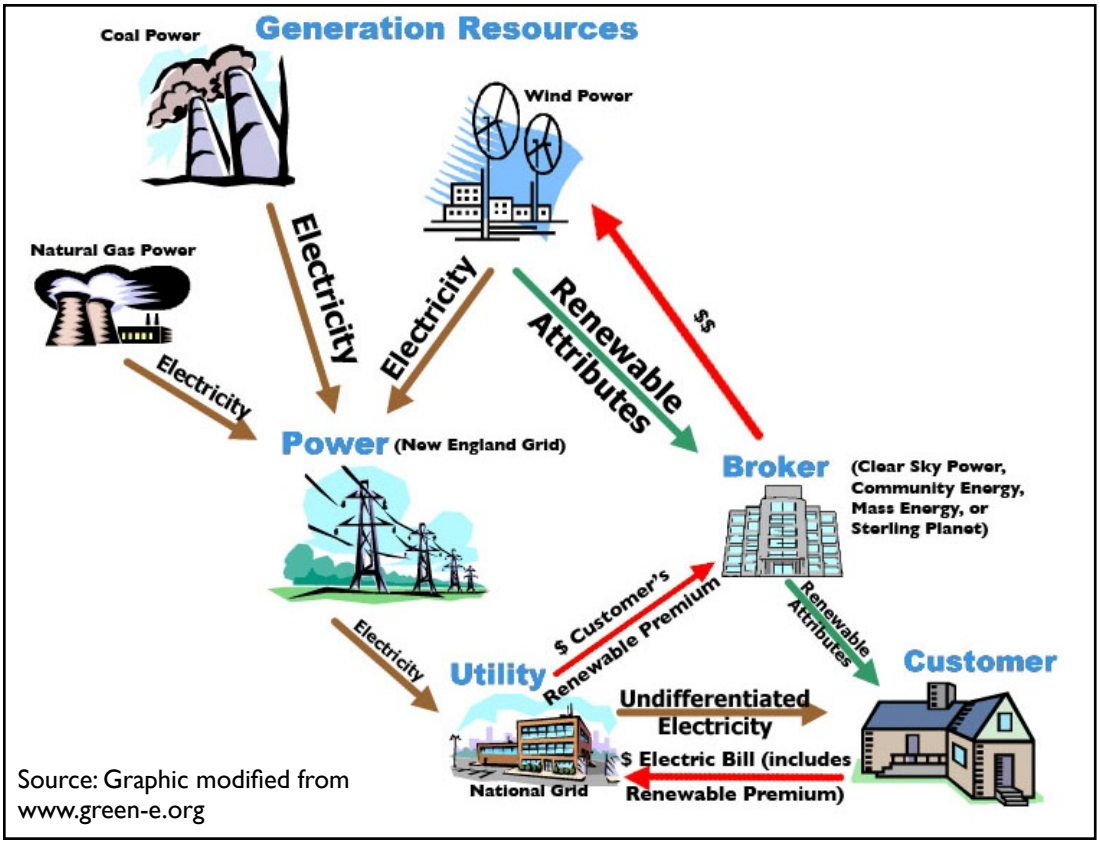


Figure 24. *Flow of Electricity, Money, and Renewable Energy Certificates*

Info on GreenUp℠ Suppliers and Clean Energy Choice® Matching Dollars

Supplier (Click on name to signup online)	Product	Price[1]	Approx. cost per month	Approx. Community Match	Approx. Low-Income Match	Sources of Energy	% New Sources[3]	% Matched	% Tax Deductable
Mass Energy Consumers Alliance 1-800-287-3950	New England GreenStart℠ 100%	2.4 ¢/kWh	$12.00[2]	$6.84	$6.84	Hydro 75% Biomass/Solar/ Wind 25%	25%	57%	57%
	New England GreenStart℠ 50%	1.25 ¢/kWh	$6.25[2]	$4.13	$4.13	Hydro 70% Biomass/Solar/ Wind 30%	30%	66%	66%
Community Energy 1-866-WIND-123	New Wind Energy® 100%	2.0 ¢/kWh	$10.00[2]	$6.00	$6.00	Hydro 70% Wind 30%	30%	60%	0%
	New Wind Energy® 50%	1.0 ¢/kWh	5.00[2]	$3.00	$3.00	Hydro 70% Wind 30%	30%	60%	0%
Clear Sky Power 1-888-833-6402	Clear Sky Home	$8.99/mo for 125 kWh	$8.99	$8.99	$8.99	Biomass 100%	100%	100%	100%
Sterling Planet 1-877-457-2306	MA Clean Choice	$7.50 mo for 150 kWh	$7.50	$5.55	$5.55	Wind 33.33% Hydro 33.33% Landfill Gas 33.33%	66.6%	74%	74%

Table 3. *GreenUp℠ and Clean Energy Choice® Details*

1 Price is in addition to you current monthly electricity bill.
2 Assumes an average of 500 kWh is consumed monthly.
3 Buying the environmental attributes of energy from new (built since 1997) renewable energy facilities is most likely to help spur clean energy development. A higher percentage of new sources also earns more matching dollars for communities and low-income prgorams.

Potential Sources of Collaboration and Resources:

- National Grid
- Massachusetts Technology Collaborative
- http://www.cleanenergychoice.org/cec_resources.htm
- Regional Environmental Council
- Clean Water Action
- Massachusetts Interfaith Power & Light

Next Steps:

- Create a goal for the number of sign ups.
- Determine the amount of funding needed.
- Determine a plan for outreach
- Create partnerships.
- Issue a challenge to City employees
- Secure outreach funding.

Clean Energy Choice® Bonus Grants

In addition to the regular monthly match, MTC is also offering a bonus grant program. The current incentives are as follows:

- If 3% of households in Worcester sign-up for GreenUp℠, the City will receive a bonus grant of $50 per household. MTC calculates 3% of households to be 2,011. This would give the City a bonus grant of $100,550. The current timeline is that 3% must be signed up by December 31, 2006 and remained signed up until March 31, 2007. However, once this date is reached a new target date will most likely be set. Currently the City has 310 households signed up.
- Each time a target date is reached the number of households signed up is calculated. Once Worcester reaches or exceeds 6% of households signed up, the City will receive a bonus grant of $50 for every new household. This is also true for 9%, 12%, and 15%.
- A City who has difficulty reaching the 3% goal may opt into a different bonus grant program. To qualify for this program, a City must gain 150 new households signed up within a year. Currently the timeline is from March 31, 2006 to March 31, 2007. If the City can do this, they will receive a 2KW solar panel installed on a municipal building of their choice. The City must also pledge to put 12 months of regular match money towards the solar panel and will not be eligible for another bonus until April 1, 2008. Currently Worcester has signed up 30 new households since March 31, 2006.

City Promotion of Clean Energy Choice®

Clearly, it is in the City's best interest to promote the Clean Energy Choice® program. As households sign up for GreenUp℠, they reduce community GHG emissions, support renewable energy, and help the City to support renewable energy and GHG reductions. The participation of households in GreenUp℠ not only gives the City monetary support to fund clean energy projects, but also shows decision makers and elected officials that their constituents want clean, renewable energy and are willing to pay a little extra for it. Each household may give a small amount extra each month, but the impact is significant when many people are doing the same thing.

To better promote the Clean Energy Choice® program the City needs to raise residential awareness of the program through an advertising campaign. The City may run PSAs in the Telegram & Gazette and Worcester Mag azine at non-profit rates and can air PSAs on WCCA (channel 13) for free. City leaders, like the Mayor, city councillors, and City Manager, can also promote the CEC program on their weekly radio and television shows. It may also be possible to have a billboard space donated to the cause. City leaders and decision makers should themselves sign up for GreenUp℠ and issue a challenge to all City employees. A competition could be implemented between departments to try to get the highest percentage of employee signups. The City can also put signup forms in with employee's paychecks.

An option for reaching out to the broader community is to issue a competition between schools. In this competition, students can receive GreenUp℠ sign-ups forms and information to bring home. The school with the highest percentage of forms returned and successfully processed can win an award and prize related to clean energy (such as a solar panel, solar lighting, solar science kits, etc.). A similar competition was successful in Newton, MA.

In recent months, the Mayors of Worcester and Salem have issued a challenge to each other and their respective consituents to reach 100 new signups first. Since then, Worcester has seen 30 new signups - this is the highest number of new signups to occur in a half year period for the City. Salem, however, has seen 72 new signups so more outreach needs to be done in Worcester. Is has been shown that people respond to City officials and to the opportunity to give the City the financial support it needs to implement clean energy projects, now the City needs to raise the awareness of CEC so that Worcester can reach the 3% goal and receive bonus grant money.

Purchase $25,000 Worth of Renewable Energy Certificates (RECs)

Implementation Cost:	$25,000 into Clean Energy Budget	**Status:** Proposed	
Annual Cost Savings:	Variable	**Sector:** Municipal	
Payback Period:	NA	**Measure Type:** Renewable Energy	
Energy Saved (kWh):	None (833,000 offset)	**Equivalent to:** A 140lb person climbing 2,257,430,000 stairs The daily electricity use of 23,314 Americans	
Tons of eCO_2 prevented/yr:	309	**Would fill:** 20,609,971 basketballs **Equivalent to driving:** 676,000 miles	
lbs. of NO_x prevented/yr:	511	**lbs. of VOCs prevented/yr:**	117
lbs. of SO_x prevented/yr:	834	**lbs. of PM_{10} prevented/yr:**	778
lbs. of CO prevented/yr:	1,061		

Co-Benefits:

- Lead by example for other Cities and for Worcester's residents.
- Help meet the 20% by 2010 municipal goal.
- Increase the demand for and development of clean, renewable sources of electricity in the region.

Success Stories:

- The City of Newton has a contract with Mass Energy to purchase $20,000 worth of renewable energy certificates each year for ten years.

Description:

In March 2005, the City Council unanimously passed a Clean Energy Resolution (see Appendix A). This resolution states that the City will purchase (or produce) 20% of the ***electricity*** used by municipal buildings and lighting from clean, renewable sources by 2010. Passing this resolution made Worcester the largest city in the country and the first city in Massachusetts to pass a 20% by 2010 clean energy resolution. The City defines clean, renewable sources to be anything that qualifies for the Massachusetts Renewable Portfolio standard (RPS) (see sidebar) or that is supported by the Massachusetts Technology Collaborative (MTC).

Sticker worn by City Councillors and residents at the 20% by 2010 vote. 35 supporters attended the City Council meeting.

The Clean Energy Resolution and goal pertains only to electricity. Other renewable energy options, such as solar air and water heating and transportation fuels, are

also helpful in reducing GHG emissions, air pollution, and supporting a secure and sustainable energy supply. The City may consider setting goals for the use of renewable sources in these contexts as well.

By purchasing renewable electricity, the City will send signals to the market that a healthier, cleaner, sustainable power source is of higher value than those that pollute our environment. The purchase of clean power can be easily marketed to display the City's commitment to renewable energy, to decreasing dependence on fossil fuels, to supporting a local economy, and to a healthier environment. This is also a way for the City to set an example that residents can follow.

To meet the 20% by 2010 goal, the City must either produce renewable electricity (and keep the RECs) or purchase Renewable Energy Certificates (RECs). A Renewable Energy Certificate is produced when electricity is generated from renewable sources (see Figures 23 and 24 in the previous measure). The City has the opportunity to purchase RECs from the clean energy supplier Mass Energy Consumers Alliance (Mass Energy). The City can purchase up to $20,000 worth of RECs from Mass Energy each year and MTC will match the amount 100%. In other words, if the City makes a $20,000 REC purchase, MTC will put $20,000 into Worcester's Clean Energy Fund and $20,000 into a competitive fund for low-income clean energy projects. The money in these funds must be used to support clean, renewable sources of electricity. MTC may also be open to increasing the dollar amount they will match per year if there is serious interest on behalf of the City. The ETF suggests negotiating with MTC to match a $25,000 purchase and then using the match money to help fund a full-time Energy Manager.

Purchasing $25,000 worth of RECs, would offset approximately 833,000 kWh, representing 1.4% of electricity used by the municipality. Entering into multi-year contracts for RECs would ensure that progress is being made towards the purchase of renewable electricity and would allow for a reduced cost per REC. If the City begins shopping early and making a commitment to suppliers and generators in advance of 2010, it should be able to acquire the RECs in a way that would provide the City a hedge against its overall electricity bill. REC contracts should have provisions that make it so that the City would have a no-penalty option to purchase fewer RECs if it became capable of producing its own RECs through renewable electricity installations.

Ultimately, reaching the 20% by 2010 clean electricity goal will require a combination of REC purchases and renewable electricity installations. The MA RPS will also help in reaching this goal by requiring all electricity sold to the City to be at least 5% from renewable sources. This means that the City will have to purchase or produce renewable electricity for the remaining 15% to reach the clean electricity goal.

Next Steps:

- Set a Clean Energy Budget of at least $25,000 / year
- Work with MTC to expand the $20,000 match to $25,000
- Set up an agreement with Mass Energy
- Publicize this action to help market Worcester as the "Green heart of the Commonwealth"

Primer on Massachusetts Renewable Energy Portfolio Standard (MA RPS)

Many states have instituted a Renewable Portfolio Standard (RPS). An RPS tells electricity sellers what percentage of electricity that they sell must be generated from clean, renewable sources each year.

Minimum Percentages of Annual Electrical Energy Sold from Qualified Clean, Renewable Sources

Compliance Year	Cumulative Minimum Percentage
2003	1.0
2004	1.5
2005	2.0
2006	2.5
2007	3.0
2008	3.5
2009	4.0

After 2009, the Minimum Standard shall increase by one percent per Compliance Year until the Division suspends the annual increase. At no time shall the Minimum Standard decrease below the percentage in effect at the time a suspension is implemented.

Eligibility Criteria for New Renewable Generation Units

Eligible Fuels, Energy Resources and Technologies:

1. Solar photovoltaic or solar thermal electric energy;
2. Wind energy;
3. Ocean thermal, wave or tidal energy;
4. Fuel cells using an Eligible New Renewable Fuel;
5. Landfill methane gas and anaerobic digester gas, provided that such gas is collected and conveyed directly to the Generation Unit without use of facilities used as common carriers of natural gas;
6. Low-emission, advanced biomass power conversion technologies using an Eligible Biomass Fuel. A Generation Unit may qualify as a New Renewable Generation Unit, provided it uses an Eligible Biomass Fuel, subject to the limitations set forth herein. Pile burn, stoker combustion or similar technologies shall not constitute an advanced biomass conversion technology.

Starting date of eligible electricity generation must be after December 31, 1997.

Install a 100KW Hydro-Power Turbine at the Water Filtration Plant

Implementation Cost:	$300,000*	**Status:** Proposed	
Annual Cost Savings:	$63,072	**Sector:** Municipal Buildings	
Payback Period:	4.8 years	**Measure Type:** Renewable Energy	
Tons of eCO_2 prevented/yr:	292	**Would fill:** 19,473,158 basketballs **Equivalent to driving:** 638,810 miles	
lbs. of NO_x prevented/yr:	484	**lbs. of VOCs prevented/yr:**	111
lbs. of SO_x prevented/yr:	789	**lbs. of PM_{10} prevented/yr:**	737
lbs. of CO prevented/yr:	1,004		

Co-Benefits:

- Strong cost savings potential
- Opportunity for publicity and residential education
- Help meet the 20% by 2010 renewable electricity goal

Success Stories:

- MTC has awarded Wellesley Rosewood Maynard Mills a $40,000 LORI feasibility grant. The project team will investigate the financial and technical feasibility of installing an 82 KW hydro system at the historic Clock Tower Place in Maynard, MA. Contact: Mr. Anthony Bongiorno 978-823-8285.[1]
- MTC provided a $500,000 grant to Verdant Power, LLC to construct and demonstrate a hydroelectric plant with capacity of approximately 20 KW utilizing six Gorlov helical turbines in the Merrimack River in Amesbury, Massachusetts. The proposed system is designed to extract useful electrical energy from free flowing river and tidal currents.[2]

Description:

Installing a small hydro-electric generator at Worcester's water filtration plant in Holden would save money on electricity costs, reduce a significant amount of eCO_2, and help the City meet the 20% by 2010 municipal clean electricity goal. The water filtration plant receives electricity from Holden Municipal Light & Power at a rate of $0.08/kWh, according to water filtration plant usage records. Twenty-three million gallons of water run into the water treatment plan each day. The calculations above are based on a 100KW hydro system (the approximate capacity under this scenario: 55ft head, 23 MGD) operating constantly at 90%. Implementation cost includes installation and is based on a price quote from a professional hydro-power installer. Another potential scenario is to install a hydro turbine to capture the power of the water that is flowing by gravity daily from Lyndebrook reservoir to Holden #2 reservoir. Under this scenario (100ft head and 6 MGD) 48KW could be produced and the equipment cost would go from ~ $125,000 to ~ $70,000. Though less power and less cost-effective, this application may be much easier to install due to the complicated piping of the first scenario.

Further cost savings may be realized from a decrease in electrical demand. Demand is the amount of electricity

required at any given point in time. Large electricity users are charged monthly based on their peak demand. The demand charge for the Water Treatment Facility makes up a large portion of the total electrical cost each month. In recent years, efficiency measures have been implemented with the help of Holden Municipal Light & Power to reduce the demand charge by approximately $2,000/month. Hydro-power can help to further lower the demand charge. Electricity cost is directly related to the amount of water being treated, and the generation capacity of the hydro turbine is also related to the amount of water running through the plant for treatment. Therefore, hydro-power can help offset electricity costs and demand when the need is highest.

MTC has stated that even though Worcester's water filtration plant is in a municipal light territory that it would still qualify for MTC funding. MTC's Large Onsite Renewable Initiative (LORI) offers rebates for installing renewable technologies, including hydropower. The next round of grant applications is due in February 2007.

Potential Sources of Funding:

- MTC Large Onsite Renewables Initiative (LORI)

Next Steps:

- Bring in a small hydro-power professional to do a site and cost assessment.
- Determine the amount of money the City has available for this project and if further funding sources are needed.
- Communicate with MTC on how to proceed to ensure funding.

*Under one potential scenario. Total cost including equipment and installation. See Appendix K for hydro power equipment price quote details.

[1] http://www.masstech.org/renewableenergy/green_buildings/lori_grants.html
[2] http://www.masstech.org/Project_lst_rslt.asp?ID=54

Solar Heat at Schools: Example Below Represents a Small Solar Heating Panel

Implementation Cost: $2,788*
Annual Cost Savings: $341
Payback Period: 8.2 years

Status: Proposed
Sector: Municipal
Measure Type: Renewable Energy

Tons of eCO_2 prevented/yr: 1

Would fill: 66,689 basketballs
Equivalent to driving: 2,188 miles

lbs. of NO_x prevented/yr: 4
lbs. of SO_x prevented/yr: 0
lbs. of CO prevented/yr: 1

lbs. of VOCs prevented/yr: 0
lbs. of PM_{10} prevented/yr: 0

Co-Benefits:

- Provides the opportunity to be a leader in solar technology.
- Can contribute towards LEED status.
- Can be implemented in new construction.
- Easy and fast to install.
- Can help satisfy air change requirements.

Success Stories:

- Houghton Place Apts. Cambridge, MA[1]
  - 840 ft2 - panel size
  - 5,000 CFM
  - Savings of 5,811 Mbtu/year
  - Saves $1,500/year in heating costs
  - Architect: Line Company Architects
  - PE: Mark Kelly

Description:

Solar air heating is a good way to reduce energy costs, particularly if heating with electricity. Solar air heating has the quickest payback period of the three solar technologies (air, water, and electricity). There are two types of solar air heating - those systems that heat outdoor air and those that heat indoor air. The ones that heat indoor air are generally more efficient because indoor air is typically already warmer. In a public building, where six fresh air changes must be completed each hour, the outdoor air heating system offers the added benefit of assisting with these air changes while still reducing energy use and costs.

Passive Solar Design

Solar air heating is meant to work in conjunction with more traditional air heating systems. It is quick and easy to install on roofs or building sides, and can be implemented in other municipal buildings besides schools.

Potential Sources of Funding:

- Clean Energy Fund
- Operating Budget
- DEP, EPA, PEW, MTC Green Building Program

*Equipment cost for a small heating system. See Appendix E and the solar heating at the airport suggestion on the following page for more details.

Next Steps:

- Bring in a solar expert to assess several predetermined Worcester public schools for solar heating, water, and electric feasibility.
- Other municipal buildings may also be considered for solar heating.
- In new construction, assess the use of active and passive solar heating in the design stage.

[1] Alternative Energy Store Solar Air Heating Presentation to Worcester's ETF, July 2006.

Solar Heat at Airport: Example Below Represents a Small Solar Heating Panel

Implementation Cost: $2,788
Annual Cost Savings: $291
Payback Period: 9.5 years

Status: Proposed
Sector: Municipal Buildings
Measure Type: Renewable Energy

Tons of eCO_2 prevented/yr: 1

Would fill: 66,689 basketballs
Equivalent to driving: 2,188 miles

lbs. of NO_x prevented/yr: 4
lbs. of SO_x prevented/yr: 0
lbs. of CO prevented/yr: 1

lbs. of VOCs prevented/yr: 0
lbs. of PM_{10} prevented/yr: 0

Co-Benefits:

- Provides the opportunity to be a leader in solar technology.
- Can contribute towards LEED status.
- Can be implemented in new construction.
- Easy and fast to install.
- Can help satisfy air change requirements.

Next Steps:

- Bring in a solar technology expert to assess various sites throughout the airport for feasibility of solar air heating, water heating, and electricity generation - costs and potential energy reduced.
- In new construction, assess the use of renewable energy and passive solar in the design stage.

Description:

Like solar air heating at schools, solar heating at the airport can also help to reduce operating costs. The airport is a large user of energy and there are plenty of opportunities for energy efficiency and solar applications. The calculations presented above and in the last measure are similar. The numbers are based on data from the Alternative Energy Store and it is assumed that natural gas is used for heating at a price of $1.57/therm for schools and other municipal buildings and $1.34/therm for the airport.

The example above represents a small solar heating panel. However, much larger systems may be installed to reduce a more substantial amount of energy use and costs. Typically larger systems are also more cost effective.

Potential Sources of Funding:

- Clean Energy Fund
- Operating Budget
- Grants from DEP, EPA, PEW, and MTC's Green Building Program

*Equipment cost for a small heating system. See description above and Apendix E for more details.

Solar Air Heating System on the Roof of Houghton Place Apts. in Cambridge, MA

Solar Hot Water at Water Filtration Plant: Example Below Respresents 1,500 Gal/Day

Implementation Cost: $24,000
Annual Cost Savings: $1,456
Payback Period: 16.5 years

Status: Proposed
Sector: Municipal Buildings
Measure Type: Renewable Energy

Tons of eCO_2 prevented/yr: 7

Would fill: 466,822 basketballs
Equivalent to driving: 15,314 miles

lbs. of NO_x prevented/yr: 11
lbs. of SO_x prevented/yr: 18
lbs. of CO prevented/yr: 23

lbs. of VOCs prevented/yr: 3
lbs. of PM_{10} prevented/yr: 17

Co-Benefits:

- Helps to reach municipal 20% by 2010 clean energy goal.
- Saves operating costs and lowers electricity demand for the filtration plant.

Success Stories:

- The Sunoco Car Wash in Markham, Canada (same latitude as Massachusetts), pre-heats its water using 40 unglazed solar collectors - each one 120" x 50". The unglazed solar panels are similar to those used to heat residential pools. Without any financial assistance, the project payback period will be 10 years.[1]

Description:

Solar hot water heating is the most efficient solar technology, with an efficiency rating of 85%. This means that 85% of the sun's energy that the panel absorbs is translated into energy that can be used for water heating. In other words, there is little waste. The water filtration plant is interested in using solar power to heat water that is needed for eye-wash stations. Because these are currently heated with electricity, this may present a good opportunity to reduce electricity use and costs as well as to support renewable electricity generation. The calculations above are based on a project implemented at Chickasaw National Recreational Area in Oklahoma. In this project, a 484 sq ft collector heats the 1,500 gallons of water used daily. The hot water is kept at 105° Fahrenheit. The hot water temperature fell below 105° Fahrenheit for 579 hours out of the year. The energy savings of this project are 18.194kWh/yr, and the system operates at a low efficiency of 34%. A solar expert should be consulted to better estimate the production capacity and costs of a solar heating project for the water filtration plant. The ETF also suggests looking into solar water heating for Worcester public schools.

Potential Sources of Funding:

- MTC, Holden Light & Power (for electrically heated water as at the water filtration plant)
- NSTAR (if normally gas heated water)
- ESCOS
- Other clean energy or climate change focused grants

Next Steps:

- Determine amount of money available or an acceptable payback period.
- Contact a solar expert to determine how to proceed.
- Seek out funding sources if needed.

[1] http://www.thesolarguide.com/solar-thermal/casestudy1.aspx

250KW Wind Turbine at New North High

Implementation Cost: $1,000,000
Annual Cost Savings: $52,000
Payback Period: 19.2 years

Status: Proposed
Sector: Municipal Buildings
Measure Type: Renewable Energy

Tons of eCO_2 prevented/yr: 148

Would fill: 9,869,957 basketballs
Equivalent to driving: 323,780 miles

lbs. of NO_x prevented/yr: 245
lbs. of SO_x prevented/yr: 400
lbs. of CO prevented/yr: 509

lbs. of VOCs prevented/yr: 56
lbs. of PM_{10} prevented/yr: 374

Co-Benefits:

- Demonstrate leadership in renewable electricity generation.
- Great education and publicity tool.
- Potential partnership with the EcoTarium and youth education opportunity.

Potential Sources of Funding:

- MTC's Large Renewables Initiative (LORI)
- MTC's Community Wind Program
- ESCOs

Next Steps:

- Allow city employees and residents to make suggestions on potenital wind sites.
- Suggestions can be reviewed by the Energy Manager and ETF and she/he can create a list of potential sites to be assessed along with a document with all of the suggestions and the pros/cons of each.
- Develop and adopt appropriate zoning ordinance to regulate wind power.
- Develop a partnership with the EcoTarium.
- Bring in a wind installer to assess the Crow Hill site and (maybe) other potential sites.
- Determine the amount of municipal money available to implement a wind installation.
- Contact MTC to determine best way to proceed.

Success Stories:

- Massachusetts Audubon Society has received a LORI feasibility grant of $40,000 to research installing a wind turbine at their location in South Wellfleet, MA. Contact: Bancroft Poor, 781-259-9500[1]
- NSTAR will evaluate the feasibility of installing a 100KW to 250KW wind turbine at its corporate headquarters in Westwood, MA. The project site includes an office building of approximately 300,000 square feet, and has secured an FAA determination of "No Hazard" for a wind turbine of 150 feet above grade level. LORI feasibility grant: $25,000. Contact:Frank Gundal, 781-441-8151.[2]
- More than 30 towns and cities across Massachusetts have explored the possibility of developing wind energy projects with MTC's Community Wind Collaborative. Some communities have reached the development phase of their projects. Others are assessing sites for meteorological (met) towers and wind turbines, monitoring their wind resources, exploring project feasibility, performing community outreach, and determining project finance and development details.[3]
- **Holy Name Highschool in Worcester, MA** received a grant from MTC for a feasibility study on installing a wind turbine. They now have received a grant $500,000 from MTC to install the turbine on the school property and are in the process of fundraising for the balance of the money needed.

Description:

Wind power has enormous potential, and it is a fast growing industry. The Energy Task Force has discussed various places throughout the city to site a wind turbine, and WPI students have published a study, "Wind Power in Worcester, MA: Siting and Permitting". One site that the ETF agrees would be good for siting a wind turbine is Crow Hill, near the EcoTarium and future site of the new North High School. The electricity would be used by North High and an educational display could be created at the EcoTarium showing the amounts of power produced and pollution prevented. There may also be other sites that the City may want to have a professional assess for wind potential. The ETF suggests setting a time period where employees and residents can suggest possible wind turbine sites that can then be reviewed by the Energy Manager (EEM) and ETF to create a list of potential sites to be professionally assessed. Some sites that were discussed in ETF meetings were the Airport - ruled out becuase of FAA regulations, The new Vocational School - may be hard to get community support here, and the capped Greenwood Street Landfill - a possibility, but need to look further into. See Appendix D for the ETF meeting notes.

The ETF invited MTC to give a presentation on the funding opportunities available to the City. There are two main options for installing a wind turbine: Community Wind Collaborative and the Large Onsite Renewable Initiative (LORI). In the Community Wind program MTC offers all of the technical services of siting a meteorological (met) tower (to measure wind speed and weather data) and installing the turbine, while the City works on garnering community support. The Community Wind program takes about a year and a half to two years to go from idea to working turbine. Much of this time is due to the 6-12 month period that is necessary for collecting wind data from the met tower. If the City is going to invest a substantial amount of money into installing a wind turbine, the potential for electricity generation should be known through actual wind data collection. LORI offers more flexibility in timing and turbine siting, but the City must hire its own professionals. LORI is a competitive grant process, and the next round is due February 2007. LORI can be used for feasibility studies (up to $40,000), design (up to $75,000), or construction (up to $500,000).

The calculations above are based on a 250KW wind turbine 50 meters tall with a wind speed of 6m/s. MTC estimates that this turbine could generate 400,000 kWh of electricity annually, about two-thirds of the current load for North High[4], for a savings of $52,000/year. A total implementation cost of one million dollars is estimated from MTC. With MTC funding, however, this may be cut in half, making the payback period about 8 years.

See Appendix J for wind resource maps in Worcester and a wind installation proposal from ECO Industries.

[1,2] http://www.masstech.org/renewableenergy/green_buildings/lori_grants.html
[3] http://www.masstech.org/renewableenergy/Community_Wind/active_communities.html
[4] Select Energy FY04

2KW of Solar Electricity Panels at the New Vocational School

Implementation Cost:	$8,000*	**Status:** Proposed	
Annual Cost Savings:	$390	**Sector:** Municipal Buildings	
Payback Period:	20.5 years	**Measure Type:** Renewable Energy	
Tons of eCO_2 prevented/yr:	1	**Would fill:** 66,689 basketballs **Equivalent to driving:** 2,188 miles	
lbs. of NO_x prevented/yr:	2	**lbs. of VOCs prevented/yr:**	0
lbs. of SO_x prevented/yr:	3	**lbs. of PM_{10} prevented/yr:**	3
lbs. of CO prevented/yr:	4		

Co-Benefits:

- Important educational resource for training vocational students in an up and coming technology.
- Publicly visible and tangible renewable energy source.
- Helps reach 20% by 2010 clean electricity goal.
- Puts Worcester on the cutting edge of technology.
- Support the local solar economy.

Success Stories:

- Mass Energy Consumers Alliance, a non-profit renewable energy company and member of the ETF, coordinated a 2.4 KW solar electric project at the Richard J. Murphy school in Dorchester, MA in 2006. The system is expected to generate 2,860 kWh annually for the school and prevent about 3,500 lbs of eCO_2. The project was funded by MTC's SRI, Dorchester's Clean Energy Fund, and a private contribution. See Appendix L for the full case study.

*Equipment cost only - assuming MTC funding from small renewable matrix of $6/watt. If PV is installed on a LEED or Energy Star certified building, the rebate amount would increase to $7.50/watt.

Description:

Solar electricity is a well-known technology in popular culture; however, it is not as efficient or cost effective as many other renewable options. Solar electricity (also known as photovoltaics or PV) does provide a public demonstration and the ability to be on the cutting edge of technology and support further PV development. This is particularly important for Worcester's vocational high school, where students should be prepared for the outside world with the latest technologies. The implementation of a solar PV would be largely for the purposes of student and resident education, and thus a small (2KW) system is suggested.

To help offset the higher cost of PVs, MTC offers two funding options. The first is the Small Renewable Initiative (SRI) which is a non-competitive grant that is dispersed on a first-come, first served basis. MTC is now in their 5th round of funding for the SRI. The amount of grant money is based on the size and application of the PV installation. F Additional grant money is earned for using solar panels manufactured in Massachusetts. Evergreen Solar in Marlborough, MA is a large solar manufacturer; the City can support the local solar economy and receive additional

grant money by purchasing the solar panels from Evergreen Solar. Locally produced renewable energy equipment not only supports the local economy, but also is environmentally-friendly becuase it only uses a small amount of fuel to transport the products to Worcester. For more information on SRI, see Appendix F. The second funding option is the solar bonus program offered by MTC as part of the Clean Energy Choice® (CEC) program. If the City can encourage 150 additional people to sign up for GreenUp℠ from March 31, 2006 to March 31, 2007, the City will qualify for a free 2KW solar PV system from MTC. The City must also commit all of their "regular" CEC match money for 12 months, and will not be eligible for another CEC bonus until April 1, 2008. As of September 30, 2006, the City has had 30 additional sign-ups since March 31, 2006. For more information on CEC see page 63.

Potential Sources of Funding:

- MTC - Small Renewables Initiative (SRI)
- MTC - 2KW PV CEC Bonus Program
- Clean Energy Fund
- School operations or education funds

Next Steps:

- Determine the amount of money the City has available for solar pv.
- Bring in a solar expert for a site, power and cost assessment.
- Contract with solar installer and determine from whom to purchase the solar panels.
- Ensure solar panels will be electronically monitored for production.
- Apply for MTC funding.

Solar Heat at the Sewage Treatment Plant: Example Below Represents a Small System

Implementation Cost:	$2,788*	**Status:** Proposed	
Annual Cost Savings:	$321	**Sector:** Municipal Buildings	
Payback Period:	8.7	**Measure Type:** Renewable Energy	
Tons of eCO_2 prevented/yr:	1	**Would fill:** 66,689 basketballs **Equivalent to driving:** 2,188 miles	
lbs. of NO_x prevented/yr:	4	**lbs. of VOCs prevented/yr:**	0
lbs. of SO_x prevented/yr:	0	**lbs. of PM_{10} prevented/yr:**	0
lbs. of CO prevented/yr:	1		

*Equipment cost for a small system. See Appendix E for more details.

Description:

The Upper Blackstone Water Pollution Abatement District (UBWPAD) is Worcester's sewage treatment plant. 90% of the waste processed by UBWPAD comes from the city of Worcester. Representatives from Worcester and the surrounding towns also serviced by the plant sit on UBWPAD's board and meet regularly. UBWPAD has been undergoing major capital investment improvements and continues to do so. The City of Worcester should be sure to collaborate with UBWPAD in its plans to improve energy efficiency and reduce GHG emissions. The City of Worcester and UBWPAD already have a good working relationship, which can be further strengthened.

UBWPAD has already completed many actions that reduce their energy use and increase efficiency. These include:

1. Use premium efficiency motors.
2. Replaced lighting with high efficiency lights.
3. Selected regenerative thermal oxidizers (RTOs) as afterburners on multiple hearth furnaces (MHFs) to reduce use of natural gas.
4. Replaced media in RTOs with more efficient media that also uses less electricity.
5. Recuperate heat from MHFs for building heat.
6. Installed flue gas recirculation in MHFs to improve thermal efficiency, reduce gas consumption, and reduce emissions of NO_x.
7. Included fine bubble aeration in design of improvements to the aeration system.
8. Incorporated high efficiency mixers in improvements to aeration system.
9. Incorporated denitrification in design of aeration system improvements to reduce need for aeration (thus electricity) and for caustic chemical addition.

Other efficiency and renewable energy measures UBWPAD will be considering in the preliminary design review of the next portion of the plant improvement project include:

1. Evaluation of wind power generation on top of capped landfill.
2. Evaluation of solar power potential.
3. Evaluation of use of fats, oils and greases as either fuel in MHFs, or as an energy supplement in the activated sludge process.
4. Consideration of acting as transfer station for FOG to send material on to conversion to biofuel.
5. Evaluation of optimal dewatering methods for solids combustion in MHFs.

There are many great renewable energy options for UBWPAD to consider. This measure takes a preliminary look at solar air heating. The calculations here are based on a solar air heating system that the Alternative Energy Store offers, and it is assumed that the plant currently heats with natural gas. This example represents only a small amount of UBWPAD heating needs, but larger systems can be installed and may also make more economic sense. Since solar air and solar water heating are typically the most cost effective, further research should be conducted on these technologies as soon as possible.

Biodiesel production and use are growing exponentially. Getting involved with biofuels now may present great cost savings and renewable energy development opportunities for UBWPAD.

UBWPAD may also consider measuring the amount of methane emissions generated in the wastewater cleanup process and looking into ways to utilize and/or reduce these methane emissions. See the sidebar below for a case study

Potential Sources of Funding:

- MTC - www.masstech.org
- Federal rebates and tax incentives
- ESCO partnerships
- NGrid and NSTAR
- Sale of Renewable Energy Credits

Next Steps:

- Bring a solar expert in to assess the potential at UBWPAD
- Other potential renewable energy experts to involve include installers of wind power and low-head hydro systems. Waste water treatment plants in both San Diego, CA and New York generate hydro-electricity.

Ecovation, Inc.
Carver, MA

MTC LORI Feasibility Grant: $18,806
Contact: Dr. Robert Hickey, 585-421-3510

Ecovation's project is located in Carver, MA at the Decar Cranberry Products, Inc. production facility. The site currently hosts a wastewater treatment facility which treats about 37,000 gallons per day. Ecovation, Inc. is a renewable resources management company specializing in the anaerobic treatment of organic wastewaters to generate biogas. The resulting biogas can be used for the generation of electric power and heat. The Carver facility is an ideal potential project site because it already produces the biogas, it has a high level of energy consumption, and the company is interested in replicating this application at other sites in Massachusetts.

source: http://www.masstech.org/renewableenergy/green_buildings/lori_grants.html

Potential Electricity Generation from Methane at Greenwood Street Landfill

Implementation Cost:	TBD	**Status:** Proposed	
Annual Cost Savings:	$1,364,184	**Sector:** Waste	
Payback Period:	TBD	**Measure Type:** Renewable Energy	
Tons of eCO_2 prevented/yr:	40,908	**Would fill:** 3,637,079,026 basketballs **Equivalent to driving:** 119,313,061 miles	

Co-Benefits:

- Can generate about half of municipal electricity with clean energy.
- Will allow the City to exceed the 20% by 2010 renewable electricity goal.
- Great opportunity for publicity and education.

Success Stories:

- Glacier Ridge Landfill in Horican, WI produces 2MW of power. After fulfilling the electrical needs of the landfill, 1890 KW are exported to the grid. Operating 94% of the time, this is equivalent to over 15.5 million kWh/year.[1]

Description:

The Clean Air Climate Protection (CACP) software allows the user to calculate the estimated amount of methane being emitted from landfills. It takes as input the year opened, year closed, and total amount of waste. The numbers above are based on the CACPS estimated methane generation from the municipally operated Greenwood Street Landfill in 2010. The software suggests using a 75% methane recovery rate for recovery systems with unknown efficiency, and a 90% rate for systems that are lined on all sides and capped with a plastic top sheet. In the calculations above, a 75% recovery rate is assumed. Based on the tons of methane that CACPS estimates will be emitted in 2010, an EPA calculator is used to determine that 27,283,680 kWh of electricity can be generated - almost half of current municipal use. Cost savings is calculated assuming that electricity can be generated for 8 cents (5 cents less than current price).

The amount of methane emitted from a landfill decreases with each year. The above calculations are based on 2010 emissions, but methane collection and electricity generation can begin sooner and produce even more electricity. This past year, the City installed a methane test well to measure the amount of methane available. The well reading has shown methane to be available at a concentration of about 50-55% pure methane. This is a typical amount for a landfill that is able to generate a large amount of electricity.[2] The Greenwood Street Landfill has been tested for methane collection before (many years ago) and it was determined that methane collection was too costly. Now, however, with the changes in technology, energy prices, and the capping of the landfill, methane collection may present a real economic and environmental opportunity. The potential for the City to reduce GHG emissions, produce renewable electricity, and spur much positive publicity through converting methane emissions to electricity is huge. More testing and feasibility studies need to be carried out to determine the actual amount of methane available for capture. With the re-capping of the landfill now taking place, there will be much more information on the percentages of methane being produced and the possible electricity generation projects.

Potential Sources of Funding:

- Grants may be available from DEP, MTC, EPA, or other organizations interested in climate change or waste pollution.

Next Steps:

- Continue to monitor test wel, install more test wells.
- Contact the proper companies for site assessments and cost estimates.
- Conduct neighborhood meetings for input.

[1] Landfill Turns Methane Into Electricity, www.dresser.com/internet/businessunits/waukesha/pages/documents/publications/casehistory/pc5_3_p7.pdf

[2] "Scottish Landfill Turns Methane into Electricity With System from Cummins Power Generation", December 1, 2005, http://news.thomasnet.com/companystory/471617.

3.3 Transportation and Vehicle Fleet

Transportation accounts for 30% of Worcester's greenhouse gas emissions. If the current trends in car ownership and driving habits continue, these emissions will grow significantly in the coming years. Action is therefore needed now. A reduction in the use of petroleum in Worcester could significantly reduce local production of GHGs. A commitment to making environmentally responsible transportation choices offers a powerful means for protecting the local air quality and reducing our production of greenhouse gases.

Not only are vehicles a major source of greenhouse gas emissions, they also contribute to ozone, smog, and particulate pollution within the City of Worcester itself. With the rising costs of gasoline and diesel fuel, the City and the community are also spending increasing percentages of their budgets on transportation.

There are three principal ways to reduce the emissions from automobiles: shift to more fuel efficient cars; switch to fuels that emit fewer pollutants; and reduce the total number of miles traveled by cars in Worcester.[1] The first alternative is becoming easier every year. Hybrid vehicles are rapidly moving from a niche to a mainstream market, and by all accounts the major car manufacturers in Japan, Europe and the US are responding to consumer interests in these technologies. Other technologies, such as ethanol and biodiesel also hold promise as the production of these fuels has been growing exponentially over the past five years.

Reducing the number of miles traveled by cars in Worcester requires a greater effort. The three ways to accomplish this are to redirect the pattern of land use and development, to consider alternative modes of transport, and to change the mobility choices made by individuals, businesses and institutions. Any future planning for land use and transportation in Worcester must consider the necessity of maintaining a strong economy and individual access to basic services and business opportunities. Increasing density near commercial centers and public transit, through mixed-use development, will encourage walking and use of public transportation, reduce auto trips and traffic congestion, and preserve valuable open space elsewhere. It will also help to maintain the character of downtown and the sense of place in Worcester.[2]

CARS & POLLUTION

- Cars are responsible for 40% of US hydrocarbon and nitrogen oxide emissions.
- Cars produce 70% of US carbon monoxide emissions.
- Roads cover 30% of developable land in the US.
- 50% of petroleum used in US is burned by cars.[3]

Locally, the City has over 2,000 streets listed in its Official Street directory.

Excerpt from CMRPC's Regional Tranportation Plan

There is a general agreement that in order to satisfy the increased transportation demand associated with economic development, while at the same time complying with the statuary requirements of the Clean Air Act, the City must diversify its transportation system to make it more efficient. Such a diversification will include:

- **Enhancement of the public transit system (bus, commuter rail, and Intermodal Transportation Center),**
- **Promotion of ridesharing (through parking policies, park-and-ride lots, and a transportation mngmt. association), and**
- **Promotion of walking and bicycling through urban design, streetscape improvements and trail creation.**

[1,2,3] Newton Climate Action Plan, February 2002

Enable 5-Minute Shut-Off in Municipal Trucks: 270 Diesel Trucks in Example Below

Implementation Cost:	$0	**Status:** Proposed	
Annual Cost Savings:	$130,151	**Sector:** Municipal Vehicle Fleet	
Payback Period:	Immediate	**Measure Type:** Transportation	
Energy Saved (kWh):	2,265,335	**Equivalent to:** A 140lb person climbing 6,139,057,850 stairs The daily electricity use of 63,419 Americans	
Tons of eCO_2 prevented/yr:	671	**Would fill:** 44,748,249 basketballs **Equivalent to driving:** 1,467,950 miles	
lbs. of NO_x prevented/yr:	8,240	**lbs. of VOCs prevented/yr:**	940
lbs. of SO_x prevented/yr:	12	**lbs. of PM_{10} prevented/yr:**	231
lbs. of CO prevented/yr:	7,325		

Co-Benefits:

- Significant cost savings for the City.
- Better use of taxpayer's dollars; less wasteful.
- Fewer headaches and health problems for vehicle operators.
- Prevention of harmful pollutants directly into Worcester's air.

Description:

Medium- to heavy-duty trucks in the City's vehicle fleet are capable of being set to automatically shut-off after a period of idling from 1-60 minutes. 5 minutes was chosen because it supports the Massachusetts 5-minute idling law (see page 84). Enabling this setting will only take a few minutes per vehicle and will prevent the City from senselessly wasting fuel and money. The calculations are based on automatic shut-offs in 270 trucks. It is assumed that each vehicle idles twice a work day for 20 minutes each time, resulting in 63,180 gallons of fuel being wasted each year. Not only does idling waste fuel and emit air pollution, but it also affects engine life and maintenance costs. Idling for 1/2 hour each day is equivalent in engine wear to driving an additional 32,000 annually.[1]

Next Steps:

- Put a plan in place for enabling the shut-off, determining who will be responsible and by when the switch should be complete.
- Do It!
- Be sure to enable shut-off on all new vehicles.

[1] American Trucking Association. 1989. Document #1419 "Diesel Idling," February 2, from www.greentruck.com/air_emissions/1419.html.

Municipal Anti-Idling Policy

In Massachusetts idling for more than 5 minutes is illegal in most situations (see sidebar). However, this law is typically not very well enforced or even advertised. The ETF suggests that the City of Worcester pass an anti-idling policy to support the state policy and to recognize the wastefulness of idling. Idling a diesel vehicle for one hour a day is equivalent in engine wear to driving 64,000 miles and using over 500 gallons of fuel annually. A gasoline vehicle wastes one gallon of fuel and emits 22 lbs of eCO2 for every hour of idling. Furthermore, emissions from idling are typically dirtier than emissions at traveling speeds. See Appendix A for a draft of a municipal idling policy for Worcester (based on Medford's Anti-Idling Policy).

Besides simply passing this policy, the City should also educate residents. Often residents do not realize that idling wastes so much fuel, costing them money and polluting the air, or they just do not remember to turn off their engine while waiting. This can be a particular problem at school pick-up sites, where typically parents wait for 10-15 minutes with their engines running and their exhaust going right into their childrens' air. The Connecticut DEP states, "research has shown that constant reminders, such as anti-idling signs, significantly improve compliance rates with an idling restriction. Therefore, DEP is continuing its efforts to reduce unnecessary idling and increase awareness of the environmental and health effects of idling on schoolchildren, by providing free anti-idling signs to Connecticut public schools that agree to post them." The City of Worcester could post anti-idling signs at schools without having to spend very much money and may even be able to receive a grant from EPA, DEP, or a transportation organization to do so.

Next Steps: Collaborate with WPS to identify key pickup areas and determine how many signs are needed. Estimate cost of printing and installation. Apply for grant funding if needed. Reduce idling - print signs, install and educate!

Sign used in Hamilton, Canada

Massachusetts General Law (MGL), Chapter 90, Section 16A, 310 Code of Massachusetts Regulation (CMR), Section 7.11 and MGL, Chapter 111, Sections 142A – 142M

MGL, Chapter 90, 16A and 310 CMR, 7.11:

"No person shall cause, suffer, allow, or permit the unnecessary operation of the engine of a motor vehicle while said vehicle is stopped for a foreseeable period of time in excess of five minutes. 310 CMR 7.11 shall not apply to:

- Vehicles being serviced, provided that operation of the engine is essential to the proper repair thereof, or
- Vehicles engaged in the delivery or acceptance of goods, wares, or merchandise for which engine assisted power is necessary and substitute alternate means cannot be made available or,
- Vehicles engaged in an operation for which the engine power is necessary for an associated power need other than movement and substitute alternate power means cannot be made available provided that such operation does not cause or contribute to a condition of air pollution."

Note: the regulation applies to all motor vehicles.

Penalties

Penalties can range from $100(MGL Chapter 90, Section 16A) to as much as $25,000 (MGL Chapter 111, Section 142A);

- Drivers and/or companies can be held responsible for paying the fine;
- Local police have the authority to enforce the law, as do health officials or other officials who hold enforcement authority.

Increase Fuel Efficiency of Vehicle Fleet by Purchasing Vehicles with a higher MPG Rating

Implementation Cost:	Variable/TBD	**Status:** Proposed	
Annual Cost Savings:	$36,738	**Sector:** Municipal Vehicle Fleet	
Payback Period:	Variable	**Measure Type:** Transportation / Vehicle Fleet	
Energy Saved (kWh):	799,988	**Equivalent to:** A 140lb person climbing 2,167,967,480 stairs The daily electricity use of 22,390 Americans	
Tons of eCO_2 prevented/yr:	224	**Would fill:** 14,938,313 basketballs **Equivalent to driving:** 490,046 miles	
lbs. of NO_x prevented/yr:	969	**lbs. of VOCs prevented/yr:**	1,267
lbs. of SO_x prevented/yr:	67	**lbs. of PM_{10} prevented/yr:**	22
lbs. of CO prevented/yr:	12,832		

Co-Benefits:

- Save money, fuel, GHG emissions, and other air pollutants
- Use resources and tax dollars more efficiently and less wastefully

Description:

To increase the fuel efficiency of the vehicle fleet, the City must purchase the most fuel-efficient vehicle in the class required, providing that the other functions are similar and the cost is not prohibitive. The calculations in this measure include increasing the fuel efficiency of vehicles within the mid-size auto class, full-size auto class, and light truck/SUV class. Upgrading from an average of 20.9 mpg to 28 mpg in the mid-size class would save $10,331 in fuel costs annually; upgrading from an average of 19.5 mpg to 22 mpg in the full-size class would save $4,645 in fuel costs annually; and upgrading from an average of 14 mpg to 22 mpg in the mid-size class would save $21,762 in fuel costs annually. The miles per gallon goals are based upon an average of the best available vehicles today as reported in the EPA's Green Vehicles Buyer's Guide; however, an even higher fleet average mpg can be obtained and should be aspired to. For example, the two-year old 2005 Ford Hybrid Escape SUV is estimated to get 36 mpg City/31 mpg Highway, much higher than the 22 mpg proposed.

Success Stories:

- On April 29, 2002 Arlington, MA passed a Fuel Efficient Vehicles Bylaw stating that vehicles purchased must be the most fuel efficient in the class required.
- Other cities that have passed similar laws include Amherst, Watertown, and Medford, MA and Providence, RI.

Next Steps:

- Pass a Fuel-Efficient Vehicle Purchasing Policy. (See Appendix A for a sample policy)
- Purchase and install a modern vehicle fleet software that can properly track mileage and fuel use.
- Develop a method for determining life cycle costs of new vehicles, and determine the increase in initial cost (if any) the City is willing to pay for more efficient vehicles.

Green Fleet Initiative

Passing a Fuel-Efficient Vehicle Purchasing Policy is a good start to creating a 'greener' vehicle fleet. In order to be able to most effectively use transportation resources, however, the City may want to consider adopting a comprehensive fleet policy as outlined in the excerpt below from ICLEI's Green Fleets brochure.

ADOPT A COMPREHENSIVE FLEET POLICY

The best way to ensure the success of a Green Fleets program is to pass an ordinance or enact an executive order that formalizes the Green Fleets process. In fact, the inspiration for the Green Fleets program is the "Green Fleets" executive order that **Denver,** Colorado adopted in 1993. This important program was the first comprehensive policy for reducing greenhouse gas emissions from municipal fleets in the country. As a result of this policy Denver municipal fleets must:

- ✔ Decrease fuel expenditures by an average of 1% per year.
- ✔ Decrease CO_2 emissions by an average of 1.5% per year.
- ✔ Include precise miles per gallon targets in vehicle bid specifications.
- ✔ Reduce fleet size, miles traveled by fleet vehicles, and downsize fleets.

An ordinance enacted in 1999 requires that all city vehicles purchased by **San Francisco,** California must meet the ultra-low emission vehicle standard (ULEV) and also requires that 10% of cars and small trucks purchased be electric. While not as comprehensive as Denver's ordinance, importantly, this ordinance addresses other issues such as fueling infrastructure, performance monitoring, and private fleets. Even if a formal policy can't be enacted, local governments should consider centralizing fleet operations. Due to better fleet management **Monterey County,** California is saving up to 10,000 gallons of gasoline a year after combining all of its fleets into one.

Green your Fleet, ICLEI written by Bill Drumheller 2000 www.greenfleets.org

There are many ways for the City to decrease fuel use, decrease CO_2 emissions, and create a greener fleet overall. On the following page is another excerpt from ICLEI's Green Fleets brochure, explaining various methods that may be used to create a comprehensive Green Fleets Initiative.

GREEN FLEETS™

WHAT SHOULD YOU DO TO GREEN YOUR FLEET?

DOWNSIZE VEHICLES

Does a building inspector need to drive a full size sedan? Probably not, but in many local governments sedans are still the vehicle assigned to staff, regardless of how appropriate the vehicle is to the duties that they perform. Matching duty requirements of staff to the smallest possible vehicle for the task is a critical component of a Green Fleets program. Smaller vehicles should be substituted for larger vehicles by phasing them in as new vehicles are purchased or by selling larger vehicles.

By purchasing 150 Dodge Neons instead of larger sedans Metro-Dade County, Florida is reducing its fleet CO_2 emissions by 600 tons a year.

OPTIMIZE VEHICLE USE

The manner in which fleet vehicles are used for travel in your city or county is a key determinant of the fleet's overall efficiency. Most importantly, schedule travel efficiently so that multiple tasks can be accomplished with one trip. With proper planning, staff should also be able to share vehicles for all or part of a trip. Software especially designed to optimize fleet vehicle routes can also be used to achieve large reductions in fuel use and emissions.

Route optimization for solid waste trucks in Toronto, Ontario is saving 140,000 gallons of fuel and reducing CO_2 emissions by 1,500 tons a year.

INCORPORATE EFFICIENCY INTO BID SPECIFICATIONS

Including a minimum fuel efficiency standard for each vehicle class in procurement specifications results in only the most fuel-efficient vehicles being purchased. Specifications can also be written so that the smallest and most efficient vehicle in its class is purchased. If life-cycle costing is used, the cost of fuel should be weighted heavily so that fuel savings accrued over the life of the vehicle are sufficiently taken into account.

Vehicle specifications in Louisville, Kentucky are based on the minimum power needed for a task, resulting in the purchase of smaller vehicles.

MAXIMIZE EFFICIENCY

A simple but important step that any city or county can take to improve the efficiency of its fleet is to ensure that regular maintenance is performed on its vehicles. Oil should be changed regularly and tires should be kept at the correct pressure at all times. Vehicles need to be operated in the correct manner as well. Employees should receive driver training and be awarded incentives for driving efficiently. Finally, establishing a policy against idling vehicles is a key component of a Green Fleets program.

Edmonton, Alberta increased average fuel economy by 20% when coaching employees on fuel-efficient driving.

ELIMINATE FLEET VEHICLES

In many cases cities and counties have more vehicles than they need in their fleets. By analyzing the operational needs of your fleet, and eliminating excess vehicles, non-critical trips will be discouraged and alternative forms of travel encouraged. Eliminating fleet motor vehicles in favor of bicycles can have substantial advantages as well. Employees can use bicycles for local trips. More over, putting police officers on bicycles offers crime enforcement advantages and substantial savings, as well as emission reductions.

The police department in Dayton, Ohio is saving 2,700 gallons of gasoline and 7.5 tons of CO_2 a year by using bicycle patrols instead of police cars.

BUY VEHICLES THAT RUN ON ALTERNATIVE FUELS

After "right-sizing" your fleet, larger vehicles will still be needed for many tasks. Because fuel efficiency gains are more difficult with medium- and heavy-duty vehicles, they are good candidates for the use of alternative fuels. However, not all fuels provide equal greenhouse gas and air quality emissions benefits. For this reason, consider using fuels like compressed natural gas (CNG), liquid natural gas (LNG), or propane (LPG).

One out of every three vehicles operated by Fort Collins, Colorado runs on propane, resulting in a reduction of 140 tons of CO_2 per year.

USE TRANSIT, BIKE, WALK, OR TELECOMMUTE

Is it necessary to drive to that meeting? Often the answer is no. Fleet vehicle usage can be substantially decreased if employees use other modes of travel. Depending on the distance; transit, a bicycle, or walking normally will suffice. Employees should be provided with transit passes and reimbursed when using transit or bicycles to travel for business reasons. Another option is to avoid travel altogether by using email, phone, or video technology to accomplish tasks by telecommuting.

By using advanced technology video-conferencing for its criminal justice department San Francisco, California is reducing 300 tons of CO_2 per year.

GO WITH ELECTRIC DRIVE

Vehicles with electric drivetrains will likely replace internal combustion engine vehicles in the future. Electric vehicles (EVs) powered by batteries and gasoline-powered generators (hybrids) are already available. These vehicles are appropriate for many tasks and, especially in the case of battery powered EVs, result in a substantial reduction in CO_2 emissions. Fuel cell vehicles powered by hydrogen are even better and are just beginning to become available. The only emission from these vehicles is water!

Chicago, Illinois is operating three transit buses that are powered solely by hydrogen fuel cells.

How Do Hybrid Vehicles Fit in to the Green Fleet Initiative?

What Is a Hybrid Electric Vehicle?[1]

A hybrid is any vehicle that uses two or more sources of power — in today's hybrid electric vehicles (HEVs), the two sources are electricity (from batteries) and mechanical power (from a small internal combustion engine). HEVs can offer the very low emissions of electric vehicles with the power and range of gasoline vehicles. They also offer up to 30 more miles per gallon, perform as well as or better than, and are just as safe as any comparable gasoline-powered car — and they never have to be plugged in for recharging. Widespread use of HEVs would help reduce our nation's growing dependence on foreign oil and cut greenhouse gas emissions by one-third to one-half.

The Toyota Prius has many innovative features:[2]

Regenerative braking: The motor recovers energy from the brakes when they slow down or stop the vehicle and uses it to recharge the battery. About 20% ofthe total energy consumed by the Prius comes from regenerative braking, which contributes to the car's excellent fuel economy.

Engine Turns Off: When engine demand is low, such as when starting, traveling at a light load, or stopping, the Prius is driven only by its electric motor and the engine is turned off. Turning off the engine when idling reduces emissions, which are dirtier while idling, and improves fuel efficiency. Idling off makes hybrids a particularly efficient (and quiet) option in city, stop-and-go traffic. Turning off the engine when traveling at a light load also provides significant fuel savings and emissions reductions because combustion engines operate least efficiently at low speeds.

Source: U.S. Department of Energy Technology Snapshot — Featuring the Toyota Prius

When engine demand is low, such as when starting, traveling at a light load, or stopping, the Prius is driven only by its electric motor, using battery power.

During normal travel, the gasoline engine engages as needed to (1) drive the wheels and/or (2) recharge the battery.

At full acceleration, the battery adds its power to the mix, which provides a very smooth and powerful response.

When decelerating or braking, the regenerative braking system acts as a generator to help recharge the battery.

The engine shuts off when the car isidling or if engine demand is low. Thegasoline engine runs only as needed to recharge the battery or run the airconditioner, which is why the Prius never has to be plugged in for recharging.

[1,2] U.S. Department of Energy Technology Snapshot — Featuring the Toyota Prius

Lighter, smaller engine: To improve efficiency, the Prius engine is sized to accommodate its average power load, not its peak load. Most gasoline engines are sized for peak power requirements, yet most drivers need peak power only 1% of the time.

Lower emissions: The Prius reduces regulated tail pipe emissions by up to 90% and greenhouse gas emissions by about 50% compared with Tier 2 standards.

More aerodynamic: The streamlined Prius exterior (0.29 coefficient of drag) reduces drag by about 14% compared with the typical family sedan.

Success Stories[3]

- King County, Washington assessed the economic life cycle of the Chevy Malibu versus the Toyota Prius, and showed that hybrids can be a viable, even profitable, alternative to conventional vehicles. King County projects a $2,660 savings per vehicle with the Toyota Prius (and this was with the 2003 model at 44mpg; the 2007 model is estimated to get 55 mpg combined city/highway).
- Using this cost methodology, the City of Houston, Texas anticipates saving about $5,900 by replacing 1997 Dodge Neons with 2002 Toyota Priuses. King County and Houston's experiences suggest that it takes 3-4 years to recover the initial cost investment
- New York City has purchased over 650 Toyota Prius vehicles for use in a range of municipal agencies, such as the Departments of Parks and Recreation, Health, Buildings, and Transportation.
- In Martin County, Florida, the Sheriff's Office uses 11 Priuses and 8 hybrid Civics for detective work, parking enforcement, and other non-emergency tasks. Due to the hybrids' great gas mileage in city traffic, the county estimates that it saves an average of $103 a month in gasoline, compared with the performance of the Crown Victoria — the typical police fleet vehicle — which gets only about 11 mpg. The Sheriff's Department still uses larger cars to chase speeders and transport prisoners, but has identified many uses where the additional engine power is simply not needed.[4]

The City of Worcester has a handful of Toyota Pruiss's and Honda Civic hybrids, ranging from 2002 to 2006. A few more of these hybrids were also recently purchased in 2006. It is difficult to monitor the MPG becuase of the archaic fleet management software. The two Toyota Priuss's that had mileage recorded for the 2006 fiscal year show MPG of 54.9 (for a 2004 model) and 38.6 (for a 2002 model). All of the City's hybrids are used by the water department, mostly for meter reading. The Priuss is best in stop-and-go in-city traffic as discussed above, so the stop-and-go of meter reading suits the Priuss well. Other hybrid models, including the Honda Civic, get slightly better gas mileage on the highway when compared to city driving becuase they use a different technology then the Priuss.

[3] Harnessing the Power of ADVANCED FLEET VEHICLES: A Hybrid Electric Vehicle Fact Sheet for Government Officials. February 2004. Written and produced by the Center for a New American Dream in collaboration with the National Association of Counties.

[4] John J. Fialka, "Police Vehicles Go Green and Help Save Green," WallStreet Journal, February 6, 2003.

Biodiesel (B-20) Pilot Program at Hope Cemetery

Implementation Cost:	$1,218	**Status:** Proposed	
Annual Cost Savings:	0	**Sector:** Municipal Vehicle Fleet	
Payback Period:	NA	**Measure Type:** Transportation/Vehicle Fleet	
Tons of eCO_2 prevented/yr:	4	**Would fill:** 266756 basketballs **Equivalent to driving:** 8751 miles	
lbs. of NO_x prevented/yr:	-1	**lbs. of VOCs prevented/yr:**	7
lbs. of SO_x prevented/yr:	-9	**lbs. of PM_{10} prevented/yr:**	0
lbs. of CO prevented/yr:	28		

Co-Benefits:

- Reduce health problems in fleet operators.
- Directly reduce harmful air pollutants in the City of Worcester's air.
- Be on the cutting edge of an up and coming technology with exponential growth and momentum.

Success Stories:

- In 2005, more than 400 major fleets used biodiesel nationwide.[1]
- The City of Medford, Boston's Fire Department, and Keene, NH are local biodiesel users.
- Thousands of government fleets, businesses, truckers and other consumers use biodiesel nationwide. See http://www.biodiesel.org/resources/users/ for some of their stories.

Description:

What Is BioDiesel?

Biodiesel is a vehicle fuel that can be used in diesel vehicles with no retrofits. Biodiesel comes in different blends (i.e. B-2, B-5, B-20, B-100). The number represents the percentage of the fuel that is made up of the "bio" portion, while the remainder is made up of diesel or ultra-low sulfur diesel (ULSD) fuel. The "bio" portion of biodiesel is created when an animal fat or vegetable oil is reacted with an alcohol, like methanol, in the presence of a catalyst, usually sodium or potassium hydroxide. Nothing is wasted in the "bio" creation process.[2]

In 2003, U.S. net petroleum imports exceeded 11 million barrels of oil per day. Almost 24% of that imported crude oil is refined into diesel fuel and heating oil for use in U.S. trucks, boats, and heavy equipment.[3] As a nation, we can displace a significant amount of petroleum by adding low levels of bio components to the diesel we use every day for transportation, industry, and recreation. According to the Energy Information Administration, the United States consumed approximately 36 million gallons of biodiesel in 2004.[4]

Why Use BioDiesel?

Health and Pollution[4]

Biodiesel is the first and only alternative fuel to have a complete evaluation of emission results and potential health effects submitted to the EPA. Results of the health effects testing comparing petrodiesel, B-20 and B-100 exhaust emissions are shown in the table below.

Exhaust Emissions	B-100	B-20
Ozone potential of Hydrocarbon Emissions	-50%	-10%
Carbon Monoxide	-48%	-12%
Particulate Matter	-47%	-12%
Sulfur Oxides	-100%	-20%
Hydrocarbons	-67%	-20%
PAH (aromatic compounds suspected of causing cancer)	most compounds reduced by 75% to 85%	compounds reduced by an average of 13%
NPAH (aromatic compounds suspected of causing cancer)	all compounds reduced by at least 90%	all compounds reduced by at least 50%
Nitrous Oxides	+10%	+ or - 2%

Table 4. *Exhaust Emissions of B-20 and B-100 when compared with petrodiesel. Source: National Biodiesel Board.*

Keene, NH
Fleet Operator, Steve Russel

"Operators have stated that the headaches they would get from operating equipment with 100% diesel has gone away while operating equipment with B-20"

Why? A Study at Keene Recycling Center comparing non-visible particulates shows an 82% reduction in B-20 vs. diesel fuel.

Biodiesel is also nontoxic and biodegradable. Tests sponsored by the United States Department of Agriculture confirm that biodiesel is ten times less toxic than table salt and biodegrades as fast as dextrose (a test sugar).[5]

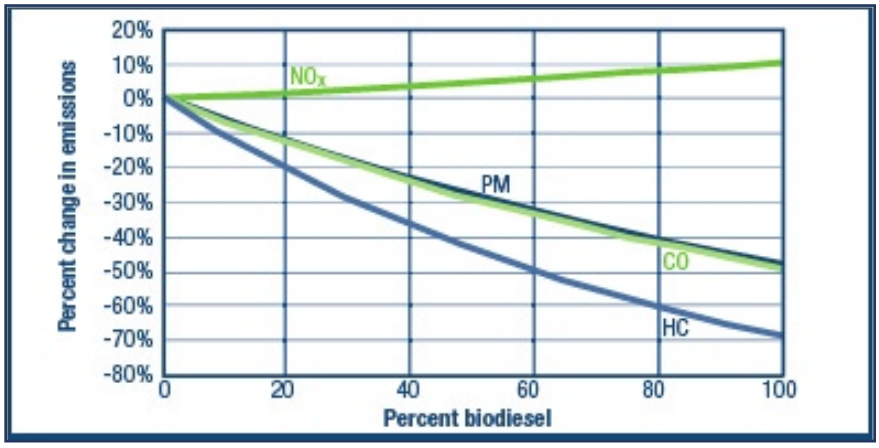


Figure 25. *Basic Emission Correlation. Average emission impacts of biodiesel for heavy-duty highway engines. Source: U.S. EPA.*

Be a Leader in Clean Technology

The production and use of biodiesel has shown an enormous growth rate since the beginning of the century. There were 3 major fleets using biodiesel[6] in 2000, and now there are over 400. According to the National Biodiesel Board, as of September 13, 2006, 85 companies have invested millions of dollars into the development of biodiesel manufacturing plants and are actively marketing biodiesel. The annual production capacity from these plants is 580 million gallons per year.

Sixty-five companies have reported that their plants are currently under construction and scheduled to be completed by early 2008. An additional 13 plants are expanding their existing operations. Their combined capacity, if realized, would result in another 1.4 billion gallons per year of biodiesel production capacity. [7]

Biodiesel is revolutionizing the transportation industry. The City of Worcester has the opportunity to be a leader in the use of this exponentially growing fuel. Soon biodiesel will become a standard, widely used fuel and, if Worcester can begin its use now, the City will be seen as a leader for other municipalities with a forward-thinking attitude and vision.

High Efficiency

Biodiesel helps preserve and protect natural resources. According to the National Biodiesel Board, for every

one unit of energy needed to produce biodiesel, 3.24 units of energy are gained. This is the highest energy balance of any fuel. Given this high energy balance and the fact that it is domestically produced, biodiesel use can greatly contribute to domestic energy security.[8]

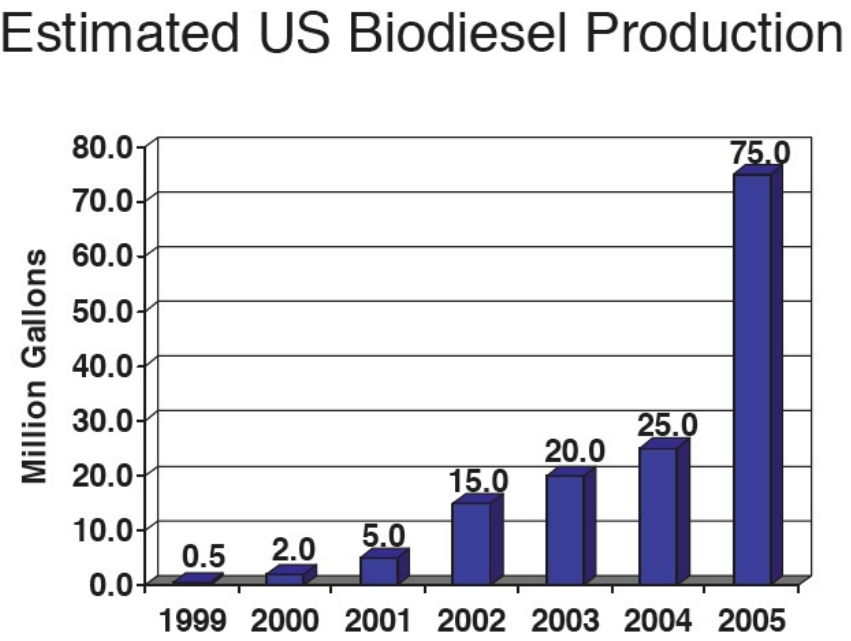


Figure 26. *Estimated US Biodiesel Production. Source: National Biodiesel Board.*

Lubrication[9]

Biodiesel's superior lubricating properties can reduce wear in diesel engines. Bench scale tests have shown that 1% biodiesel can improve the lubricity of diesel fuel by as much as 65%. The lubricity of biodiesel is important because EPA regulations now require the use of ultra-low sulfur diesel fuels in all U.S. highway diesel engines. Ultra-low sulfur diesel fuels can have poor lubricating properties and typically include an additive to correct for this. Low levels of biodiesel used as a lubricity additive can help solve this problem.

Concerns About BioDiesel

Does using biodiesel affect OEM engine warranties?[10]

Many fleet managers remain concerned about the answer to this question. The National Biodiesel Board (NBB), the trade association for the biodiesel industry, has been addressing the warranty issue. "Typically, an engine company will define what fuel the engine was designed for and will recommend the use of that fuel to its customers," the association's Web site notes. "If there are engine problems caused by a petrodiesel or biodiesel fuel, these problems are not related to the materials or workmanship of the engine, but are the responsibility of the fuel supplier and not the engine manufacturer." The most important aspect regarding engine warranties and biodiesel is whether an engine manufacturer will void its parts and workmanship warranty when biodiesel is used, and whether the fuel producer or marketer will stand behind its fuels should problems occur. "Any reputable fuel supplier (biodiesel, petrodiesel, or a blend of both) should stand behind its products and cover any fuel quality problems if they occur. Most major engine companies have stated formally that the use of blends up to B-20 will not void their parts and workmanship warranties. This includes blends below 20% biodiesel."

Several statements from engine companies, including Caterpillar, Cummins, Detroit Diesel, International and John Deere, are available on the NBB Web site at www.biodiesel.org. Some manufacturers have already specified that the biodiesel must meet the new ASTM D-6751 standard for biodiesel, while others are still in the process of adopting it or have their own set of guidelines for biodiesel use. Fleet managers should consult manufacturers for clarification. Furthermore, the recent requirement of ultra low sulfur diesel fuel has caused most manufacturers to switch to components suitable for use with biodiesel.[11] The U.S. Department of Energy states, "With proper fuel tank maintenance and fuel blending, biodiesel blends of B-20 or lower can be used in any diesel engine, including those with advanced fuel injection systems—without reducing reliability or durability. User feedback suggests that maintenance requirements for diesel engines operating on biodiesel blends of B-20 or less are identical to those operating on standard diesel."[12]

A BioDiesel Pilot for Worcester

The Energy Task Force suggests that the City implement a pilot program at Hope Cemetery. Hope Cemetery has a 1,000 gallon diesel tank where eight vehicles and machines fuel. In the fiscal year 2005, 1,965 gallons of diesel were used by Hope Cemetery. This represent only a small amount of the diesel used by the entire municipality, but it is a good place to start. Implementing a pilot program at Hope Cemetery will allow the City to track costs and benefits and to become familiar with the proper management of biodiesel as well as respond to any unanticipated issues or benefits. After a year of using B-20 at Hope Cemetery, the Energy Manager along with appropriate employees in the Hope Cemetery Department should issue a report detailing the successes, obstacles, and recommendations for the future. From this report, the City can determine how to proceed and whether to continue, expand, or discontinue the municipal biodiesel program. For recommendations on how to use biodiesel properly, see Appendix N.

Clark County Public Works Department, Vancouver, Washington

"Clark County was the first agency in the Portland, Oregon, area to bring biodiesel into the picture", states Charles Masco, operations manager for the Clark County Public Works Department in Vancouver, Washington. "Clark County started using B20 in March 2002 and uses the fuel in its entire fleet of diesel vehicles and heavy equipment, including one-ton, five-yard, and ten-yard work trucks, school buses, and paving and off-road equipment. Also, several outside agencies are purchasing the fuel from us for about 200 pieces of equipment." Annual diesel fuel usage for Clark County is approximately 189,000 gallons.[13]

Potential Sources of Funding:

- MA DEP
- Federal Tax Credit
- Local load/demand aggregation

Resources:

- National Biodiesel Association. The most up to date information on biodiesel: production, users, suppliers, OEM statements and more. www.biodiesel.org, info@nbb.org, (800) 841-5849,

Next Steps:

- Educate Hope Cemetery fleet director on the proper process of switching to B-20.
- Determine if a separate RFP is needed to purchase B-20 in the short term.
- Include B-20 specifications in the next RFP for vehicle fuel.
- Look into aggregating demand with other local communities.

1 Newton Climate Action Plan, February 2002.
2 National Biodiesel Board, www.biodiesel.org, Accessed October 2005.
3, 9 Clean Cities Fact Sheet, April 2005, Sponsored by the U.S. Department of Energy, Energy Efficiency and Renewable Energy Office of Weatherization and Intergovernmental Programs, Prepared by the National Renewable Energy Laboratory (NREL). DOE/GO-102005-2029, www.eere.energy.gov/cleancities.
4 National Biodiesel Board, "Biodiesel Emissions", www.biodiesel.org, Accessed October 2005.
5, 8 National Biodiesel Board, "Environmental Benefits", www.biodiesel.org, Accessed October 2005.
6, 10, 13 NAFA Fleet Executive, "The Right Choice?: Fleets report on biodiesel's real-world performance", September 2003.
7 National Biodiesel Board, "U.S. Biodiesel Production Capacity", www.biodiesel.org, Accessed October 2005.
11 National Biodiesel Board, "Technical Recommendations for the Use of B-20", June 2005, www.biodiesel.org, Accessed October 2005.
12 U.S. Energy Information Administration, "Monthly Energy Review, October 2004," www.eia.doe.gov/emeu/mer/contents.html. 2 U.S. Environmental Protection Agency, (2002) "A Comprehensive Analysis of Biodiesel Impacts on Exhaust Emissions, Draft Technical Report," EPA420-P-02-001, www.epa.gov/otaq/models/analysis/biodsl/p02001.pdf.

Increase Employee Carpooling

Implementation Cost:	To be determined	**Status:** Proposed	
Annual Cost Savings:	$624/person	**Sector:** Employee Commute	
Payback Period:	NA	**Measure Type:** Transportation	
Energy Saved (kWh):	16,320,410	**Equivalent to:** A 140lb person climbing 44,228,311,100 stairs The daily electricity use of 456,787 Americans	
Tons of eCO_2 prevented/yr:	4,742	**Would fill:** 316,238,746 basketballs **Equivalent to driving:** 10,374,098 miles	
lbs. of NO_x prevented/yr:	24,460	**lbs. of VOCs prevented/yr:**	29,471
lbs. of SO_x prevented/yr:	1,378	**lbs. of PM_{10} prevented/yr:**	649
lbs. of CO prevented/yr:	301,584		

Co-Benefits:

- Saves employees money
- Directly reduces pollution that aggravates asthma
- Reduces oil consumption and dependence on foreign sources; conserves resources
- Provides a leadership example to local businesses
- Increased work-place interaction and unity

Success Stories:

- The City of Austin is a Commute Solutions partner (see resources below) and offers a variety of options and financial incentives to make alternative modes of transportation more attractive to its employees. These include compressed work week, telecommuting, parking cash-out if a parking space is foregone, subsidized bus passes, reduced vanpool fees, priority parking, and bicycle conveniences.[1]

Traffic Congestion in America[2]

- Congestion costs $63.1 billion per year.
- The annual delay per rush hour (peak period) traveler, has grown from 16 hours to 47 hours since 1982.
- "Rush hour" now lasts six to seven hours a day.
- The number of urban areas with more than 20 hours of annual delay per peak traveler has grown from 5 in 1982 to 51 in 2003.
- Commuters waste 2.3 billion gallons of fuel simply from idling in traffic jams.

Increase Employee Carpooling

Description:

In the city of Worcester, transportation accounts for 30% of GHG emissions. One way of changing individual transportation behavior is to offer incentives for alternatives. In this measure the alternative is carpooling. The calculations above assume that half of city staff begin carpooling, thus reducing vehicle miles traveled by approximately 25%. It is clear that when each resident's transportation emissions are added together, the pollution emissions and costs are very large. If just 1,705 people switch from driving alone to carpooling, each person could save approximately $624/year and together 4,742 tons of eCO_2 would be prevented.

The City of Worcester could encourage carpooling by municipal employees by educating them about the benefits and making it easy for employees to find others that come from the same areas. Perhaps an interdepartmental challenge could be issued to give employees an incentive to carpool or otherwise reduce their GHG emissions from commuting. To overcome some of the obstacles presented by carpooling, the City can follow the lead of other communities and guarantee a ride home in the case of an emergency or provide low-emission vehicles that can be signed-out by employees for errands or meetings off-site. The following two measures discuss employee telecommuting and commuting by public transportation, biking or walking.

Potential Sources of Funding:

- Educational grants potentially from EPA, PEW, DOT (http://www.fta.dot.gov/funding/grants_financing_263.html), MA EOT, or regional tranportation organizations.

Resources

- Best Workplaces for Commuters℠ - A program of EPA and DOT. http://www.bwc.gov/
- The Commute Solutions of Central Texas is a business/government partnership that promotes a voluntary initiative striving to educate commuters in the region on the benefits of commute solutions. http://www.commutesolutions.com/

Next Steps:

- Create an electronic survey for employees to fill out about their daily commute (samples can be found at MA DEP, ICLEI, and BWC). This will help to determine where reductions attempts should be made and to measure the results of education in changing commuter patterns.
- Create an online carpool message board for city employees so that workers coming from the same areas may easily link up.
- City Manager should send out an email to employees requesting that they complete the survey, announcing the creation of the carpool e-board, and encouraging employees to carpool - highlighting the benefits.

[1] City of Austin. http://www.ci.austin.tx.us/airquality/employee.htm. Accessed October 2006.

[2] Highlights from Texas Transportation Institute 2005 Urban Mobility Study. http://www.bwc.gov/about/facts.htm

Offer Employee Telecommuting

Implementation Cost: $0
Annual Cost Savings: $240/person
Payback Period: NA

Status: Proposed
Sector: Employee Commute
Measure Type: Transportation

Energy Saved (kWh): 1,567,890

Equivalent to:
A 140lb person climbing 4,248,981,900 stairs
The daily electricity use of 43,883 Americans

Tons of eCO_2 prevented/yr: 456

Would fill: 30,410,137 basketballs
Equivalent to driving: 997,594 miles

lbs. of NO_x prevented/yr: 2,350
lbs. of SO_x prevented/yr: 132
lbs. of CO prevented/yr: 28,973

lbs. of VOCs prevented/yr: 2,831
lbs. of PM_{10} prevented/yr: 62

Co-Benefits:

- Employees are able to spend work time more efficiently, rather than spending time and energy traveling.
- Provide a leadership example to local businesses.

Success Stories:

- IBM's corporate culture strongly supports telecommuting. More than 32,000 IBM employees participate in the company's work-from-home "e-commute" program. Numerous locations also implement commuter assistance programs that provide employees with guidance on using alternative modes of transportation and Emergency Ride Home programs. Many locations also provide access to onsite amenities such as cafeterias and credit unions.

Description:

If feasible, telecommuting can offer the great benefits of reducing GHG emissions and other air pollution, saving money, and saving time. For employees who do not need to be on site all the time, telecommuting is a good solution to these issues. The calculations above are based on 1/8 of city employees who drive alone (426 people) telecommuting one day a week (50 days/year). City department heads need to determine if telecommuting is right for their employees and, if so, how often.

Similarly, City Departments may offer compressed work week scheduling, such as 4 10-hour days a week or 8 9-hour days and 1 8-hour day in two weeks (thus eliminating one work day every two weeks).

Next Steps:

- The feasilbility of telecommuting will have to be determined by individual department heads.
- If it is feasible, they will have to decide on the number of telecommuting days that are appropriate.
- Once these two steps are completed, employees must be educated about this option (aka benefit).

[1] Best Workplaces for Commuters, Last updated: October 30, 2006, http://www.bwc.gov/campaign/f500_top20.htm#intel.

Increase Employee Commuters Traveling by Public Transport/Biking/Walking

Implementation Cost:	Unknown	**Status:** Proposed	
Annual Cost Savings:	$1,247/person	**Sector:** Employee Commute	
Payback Period:	NA	**Measure Type:** Transportation	
Energy Saved (kWh):	8,153,028	**Equivalent to:** A 140lb person climbing 22,094,705,880 stairs The daily electricity use of 228,193 Americans	
Tons of eCO_2 prevented/yr:	2,369	**Would fill:** 157,985,995 basketballs **Equivalent to driving:** 5,182,673 miles	
lbs. of NO_x prevented/yr:	12,219	**lbs. of VOCs prevented/yr:**	14,722
lbs. of SO_x prevented/yr:	689	**lbs. of PM_{10} prevented/yr:**	324
lbs. of CO prevented/yr:	150,659		

Co-Benefits:

- Increase customer base of WRTA and/or MBTA.
- Encourage active living.
- Increase sense of community and place.
- Provide a leadership example to local businesses.

Success Stories:

- Microsoft offers a comprehensive and extensive commute program, which includes providing a FlexPass to all full time Microsoft employees in the Seattle area free of charge. The pass is good for all rides on King County Metro and Sound Transit services to Microsoft. Microsoft also provides a $65 vanpool subsidy.[1]

Description:

As discussed in the previous two measures, encouraging municipal employees to use alternative modes of transportation rather than driving alone provides Worcester the opportunity to substantially reduce GHG emissions as well as to provide a leadership example to other businesses in the city and beyond. In this measure it is assumed that 1/8 of City employees who drive alone (426 people) switch to using public transportation, biking, or walking each work day. Incentives the City can offer to employees include subsidized bus and train passes, bicycle storage and showering areas, and extra pay for forgoing a parking space. Furthermore, the City can offer subsidized bus passes to visitors wherever parking validation is typically provided.

Potential Sources of Funding:

- Education grants from EPA, PEW, MA DEP
- Partnerships with WRTA, MBTA, and/or local bike shops

Next Steps:

- Determine feasibility of various incentives.
- Create partnerships with WRTA and MBTA.
- Educate employees.
- Report on successes, obstacles, and solutions.

[1] Best Workplaces for Commuters, Last updated: October 30, 2006, http://www.bwc.gov/campaign/f500_top20.htm.

Increase Biking and Walking as a Means of Transport

There are many reasons the City should be interested in promoting biking and walking to its residents and visitors. Clearly, it would reduce vehicle GHG emissions and air pollution, but it would also decrease traffic congestion, encourage healthier lifestyle choices, and create a greater sense of community. Encouraging bicycle use and walking promotes active living and may encourage the average citizen to take greater interest in maintaining and expanding the city's parks and open spaces.

Thirty years ago, the sight of children walking and biking to school was common – 66% of all children did so. Now, however, only 13% walk to school. Even among children living within a mile of their school, only 25% are regular walkers. Planning and health studies consistently show that suburban, car dependent life is taking a toll on our health. Inspired to protect public health, communities across the country are making an effort to minimize pollution and maximize pedestrian and bicycle access through more efficient land use and transportation planning.[1]

Municipal approaches to making Worcester more walkable and bikeable

Goals

- Make bicycle and pedestrian facilities planning a routine part of the City's land use and transportation planning
- Make bicycle and pedestrian impact an assessment factor in zoning review
- Follow design guidelines that encourage pedestrian-oriented, vital urban centers
- Ensure that land development and commercial and residential construction incorporate amenities which promote bicycling, pedestrian activities and use of public transportation
- Consider traffic calming program/measures that enhance safety and mobility of non-auto users
- Coordinate with open space planning to create or improve off-road bicycle and pedestrian paths

Specific Strategies

- Establish City bicycle and pedestrian programs (or combined program) or committees
- Develop City bicycle plan and pedestrian plan
- Create Safe Routes to Schools program
- Support planning and development initiatives to build and maintain sidewalks
- Reward developers who provide access to low-emissions modes of transportation (public transit, walking paths, and bicycle parking) at new developments

- Tie special permit granting to development of pedestrian-friendly outdoor areas linked to adjacent public and private ways
- Strengthen education and enforcement program to ensure sidewalks are kept clear of snow and ice
- Increase street tree planting
- Create City employee bicycle/pedestrian commuter incentive program
- Encourage area large employers to create employee bicycle/pedestrian commuter incentive programs
- Encourage area merchants to create incentives

for customers to utilize bicycling and walking to reach destination
- Survey and improve bicycle parking and storage options at all schools, public buildings, and transit stops
- Coordinate with city department of public health on signage and maps related to active living
- Support Worcester's role as link between mass central rail trail and blackstone bikeway (as part of east coast greenway)

Sources of Funding:

- Fines for potential traffic hazards could generate additional funds for the City, some of which could be used for production and distribution of bike-related educational materials.
- Grant funding for education programs.
- Small tax rebates could be given to businesses that install bike parking.

You can benefit by leaving your car at home:[2]

Improve Health: A great way to fit regular exercise into your hectic schedule.

Decrease Pollution: Short car trips—those that are most easily made on foot or by bike—are up to three times more polluting per mile than long trips by car.

Save money: Driving alone as little as ten miles round trip each day can cost you up to $1,000/yr.

Increase Mobility: A car gets stuck in congested traffic, but you can park a bike quickly and close to your destination, and on foot there is no need to park at all!

[1,2] City of Newton's Climate Action Plan, February 2005

Increase WRTA Ridership as a Means of Transport

Like biking and walking, encouraging residents to use public transportation as a means of travel is also important to reducing GHG emissions, air pollution, and traffic congestion. Worcester is fortunate to have both a widespread bus system within the city, the WRTA, and a commuter rail between Boston and Worcester. The challenge now is to increase ridership. Obviously, this is an important business issue for the WRTA and MBTA, but it also affects the City. Increasing ridership can reduce vehicles on the road as well as encourage residents to visit new places.

The key to increasing ridership is to make it cost effective and timely for the rider. The City should work to ensure that commuter rail costs are made and kept low, and that enough trips are available to make using the MBTA a feasible option for residents both working and visiting in Boston or Worcester. All public transportation trips should be reliable in terms of schedule and comfortable in order to encourage residents to take them.

The City could partner with the WRTA to provide City employees with subsidized bus passes. In addition, the WRTA could also partner with other local business, including the many universities and colleges in the city. Thousands of students come to Worcester each year and they all need to get places. The WRTA could partner with universities to offer a bus pass as a part of the tuition fee, particularly at those schools that have parking shortages.

In terms of the commuter rail, information would have to be collected on the number of people commuting to Worcester from Boston. If enough employees make this commute, a partnership could also be developed with the MBTA to offer subsidized passes and ensure that the commuter train schedule is adequate.

3.4 Waste and Recycling

There are two major sources of emissions from the generation of solid waste, one direct and one indirect. The direct GHG emission source is the decomposition of organic waste which produces the powerful greenhouse gas, methane (CH^4). Businesses that produce significant amounts of organic waste, such as food and paper waste, can help reduce this by composting (in the case of food waste) and simple waste reduction measures such as printing double-sided copies. The indirect source of GHG emissions comes from the energy needed to produce the raw materials required to manufacture a product. By recycling and purchasing products with high recycled content, Worcester can cut down on both of these emission sources.

In 2005, Worcester recycled 17% of its waste, composted 35%, and sent 48% to Wheelabrator Incinerator. In January of 2008, Worcester's contract with Wheelabrator will be up for renewal and the cost is anticipated to double. Increasing Worcester's recycling rate can help to offset this increased cost while also reducing GHG emissions and educating the public.

The City has the opportunity to change its curb-side residential recycling program to single-stream recycling, meaning that all recyclable materials, including paper, can and will be mixed together. If the City chooses to go single stream, it will no longer receive a monetary credit for recyclables collected. Waste Management and MRF/FCR in Auburn anticipate that the ease of single-stream recycling may increase residential recycling rates by 2% but may not be enough to makeup for the lost revenue from recycling credits. A benefit of single-stream recycling is that one truck can pick up both the trash and the recycling, whereas currently it must be done with two trucks. This cuts labor and vehicle emissions in half, saving money and fuel, and is particularly helpful if both the trash and recycling are going to the same place.

Curb-Side Recycling

Implementation Cost:	$1,600,000	**Status:** Existing	
Annual Cost Savings:	$855,522	**Sector:** Waste (Municipal)	
Payback Period:		**Measure Type:** Waste Reduction	
Tons of eCO_2 prevented/yr:	34,562	**Would fill:** 2,304,901,634 basketballs	
		Equivalent to driving: 75,611,464 miles	

Co-Benefits:

- Prevents emissions from incineration.
- Reduces the energy needed for new products.
- Educates the community on waste and energy.

Description:

In 1994, the City of Worcester began a curb-side recycling program and a pay-as-you throw trash program. Worcester residents were no longer charged waste disposal taxes in their real estate taxes, but instead had to pay 50 cents each for special Worcester trash bags. Recycling, however was free. At the outset of the program, the rate of recycling was 36.5%, meaning that recycling made up 36.5% of the waste while bagged trash made up 63.5%. Since that time, the rate of recycling has been on a slow decrease, with 2005 rates showing only 26.6% of waste being recycled. Still, however, the amount of greenhouse gas emissions that were prevented in 2005 from recycling just a quarter of the city's waste (9,735 tons) represents about 17% of total municipal GHG emissions. According to MassDEP for the CY04, Worcester generates 116.1 lbs of recycling per capita, placing the city 80th among the 351 cities and towns of Massachusetts. This number does not, however, consider the total amount of waste; less recycling could potentially mean that there is less total waste rather than that the rate of recycling is lower.

The City of Worcester pays a flat rate for recycling services. For the 2006 fiscal year, this amount was $1,600,000. Cost savings result from 9,735 tons of recyclable materials being diverted from the waste stream at a cost savings of $36.52/ton (2005) as well as reduced sanitation crews. Crews were reduced from 33 personnel/day to 18 personnel/day or 15 positions, resulting in a cost savings (in 1994) of approximately $5000,000. Next year the cost of waste disposal is predicted to double; since the recycling fee will remain at a flat rate, increasing the residential recycling rate can save the City a significant amount of money through reduced disposal costs.

Encourage Recycling at Apartment Complexes

Implementation Cost: TBD
Annual Cost Savings: TBD
Payback Period: TBD

Status: Proposed
Sector: Waste (Community)
Measure Type: Waste Reduction

Tons of eCO_2 prevented/yr: 11,184

Would fill: 745,848,616 basketballs
Equivalent to driving: 24,467,294 miles

Co-Benefits:

- Prevents emissions from incineration.
- Reduces energy needed for new products.
- Educates the community on waste & energy.

Success Stories:

- St. Tammany Parish in Louisiana requires all licensed haulers to provide a residential curb-side recycling program. The program mandates weekly collection and requires that haulers maintain records of the recycling program to document the effectiveness of the program's volume reduction and to guarantee that the material is being taken to a recycling facility or direct market.[1]

Description:

The City of Worcester currently is responsible for trash and recycling pickup from city-owned buildings and residences (not including residential complexes). The CIty collects from residential housings with six units or less. As a result, people at the majority of businesses and residential complexes do not have an easy way to recycle their waste. The potential here for GHG emission reductions is huge. In the scenario above, 15,000 households in large apartment complexes are given the option to recycle onsite. Including other businesses in this measure would drastically increase the tons of waste that could be recycled, especially in businesses that use a lot of paper. The measure assumes the current recycling amount of .21 tons/household/year.

All trash in Massachusetts (residential and commercial) is subject to the state waste bans and therefore is subject to inspection and rejection at any Massachusetts landfill or incinerator if banned materials are present. Despite this law, many privately owned buildings and residential complexes still do not provide recycling. The Town of Brookline is considering passing a by-law to require private haulers with scheduled commercial and residential solid waste pickups to inlcude recycling as well. This may make it easier for business owners to take advantage of recycling programs.

Potential Sources of Funding:

- MassDEP

Next Steps:

- Create a simple how-to guide showing businesses and large residential complexes what they can do to implement a recycling program, including who to contact, potential benefits, and a case study (preferably from within the City government). Many of these guides already exist from DEP and EPA. They can be simplified and tailored for Worcester.

[1] Brookline Climate Action Plan, February 2002

City-Wide Composting

Implementation Cost:	TBD	**Status:** Existing	
Annual Cost Savings:	$730,400	**Sector:** Waste (Municipal)	
Payback Period:	TBD	**Measure Type:** Waste Reduction	
Tons of eCO_2 prevented/yr:	4,034	**Would fill:** 269,023,008 basketballs **Equivalent to driving:** 8,825,202 miles	

Co-Benefits:

- Creates an excellant nutrient rich soil source
- Allows easy leaf clean-up for residents
- Teaches residents about composting

Description:

The City of Worcester started a composting program in 1992. Multiple times during the fall residents are asked to rake all leaves into the street and the City collects them for compost. Residents are also allowed to bring their yard waste (i.e. grass clippings, branches, bruch, and tree limbs) to three different sites within the city. Yard waste is banned from disposal in Massachusetts, and the City will not pick up yard waste with trash. The DPW Yard Waste and Leaf Program has eliminated a substantial amount of banned material from the solid waste stream, thereby reducing disposal costs as well as providing finished compost for community gardens, residents and City-owned lands. The City offers residents an environmentally friendly solution to the growing demands associated with the disposal of yard waste and leaf products in an urban environment. Worcester's municipal composting program has been held up as a national model and has helped the city receive the All American City Award. Worcester received the All American City Award in 1949, 1960, 1965, 1980/81 and 2000 and is one of two communities nationwide that has won this award five times.

Residential Composting

To further reduce the amount of waste, the City should actively promote their own composting program as well as residential composting. Currently the Department of Public Works offers two different types of compost bins for home use to Worcester residents. The "Brave New Composter" and the "Earth Machine" each cost $35.00 and can be purchased at: Department of Public Works, Customer Service Center, 76 East Worcester Street. For the 2007 fiscal year, the City has been granted 90 home composting bins from DEP and 75 rain barrels. Rain barrels help residents to reduce water consumption by collecting and using rain water for irrigation. Conserving water also helps conserve the energy that is used to treat the water and wastewater.

It may be possible for the City to recieve grant funds from MassDEP to promote their residential composting program, encouraging Worcester residents to purchase, make, and use compost bins and rain barrels. See Appendix F for details.

Every ton of waste that is turned into compost reduces 403 lbs of eCO_2 (CACPS) and also saves the City in disposel fees. This pollution prevention is equivalent to the pollution emitted by driving 441 miles.

Youth at the Regional Environmental Council learn how to construct their own home composting bins.

Success Stories

Seattle, WA has an aggressive how-to compost educational program accompanied by compost bin giveaways. It has been estimated that eventually, 70% of the targeted population will compost 70% of its yard waste. This means that approximately 49% of the City's yard waste will eventually be composted at home.[1]

[1] Brookline Climate Action Plan, February 2002

Increase Residential Recycling Rate from 27 Percent to 50 Percent

Implementation Cost: TBD
Annual Cost Savings: $312,776
Payback Period: TBD

Status: Proposed
Sector: Waste (Municipal)
Measure Type: Waste Reduction

Tons of eCO_2 prevented/yr: 30,407

Would fill: 2,027,809,270 basketballs
Equivalent to driving: 66,521,549 miles

Co-Benefits:

- Participation in home recycling programs will broaden support for other public environmental problems as residents become aware of the need to take responsibility for the waste they produce.
- Conserves finite and limited supplies of natural resources (oil, mineral, timber etc.).
- Reduces waste disposal fees.

Success Stories:

- In Claremont, CA a program to raise participation rates in curb-side recycling involved oral presentations by Boy Scouts and commitment cards signed by residents in support of the recycling program. After these measures were implemented, recycling rates increased by 42%.[1]

Description:

Increasing Worcester's recycling rate is one of the most powerful actions the city can take in reducing GHG emissions. The majority of residential waste can be recycled or composted with ease. To increase the recycling of residents, Worcester could launch an educational campaign on how to recycle easily. DPW already does a great job educating residents on what they can and can't recycle; now it's time to offer tips on how to recycle and reduce waste. Reducing residential waste has a huge affect on reducing greenhouse gas emissions and a huge effect on cost savings for the City and the tax-payers. Educating the public about their waste allows residents to take responsibility for their "environmental footprint" and can create a sense of pride, interconnection and duty.

The calculations above are based on the recycling rate increasing to 50%, meaning that half of residential waste gets recycled and half gets bagged in yellow trash bags and sent to the incinerator. In 2005, recycling made up only 26.6% of the residential waste stream; achieving a 50% recycling rate would mean nearly doubling the amount of waste that gets recycled.

Potential Sources of Funding:

- MassDEP
- EPA

Next Steps:

- Educate residents on how to make it easy to recycle (i.e. put a small bin for recyclables next to every trash bin in the house).
- Recycle at schools.

[1] Brookline Climate Action Plan, February 2002

Recycle at Schools

Implementation Cost: TBD
Annual Cost Savings: $152,376
Payback Period: TBD

Status: Proposed
Sector: Waste (Municipal)
Measure Type: Waste Reduction

Tons of eCO_2 prevented/yr: 14,813

Would fill: 987,862,620 basketballs
Equivalent to driving: 32,406,475 miles

Co-Benefits:

- Provides an opportunity to teach students about the importance of recycling and sustainable living.
- Provides the opportunity for substantial cost savings.

Success Stories:

- All schools in Cambridge, MA have comprehensive recycling programs for mixed paper, corrugated cardboard, kitchen bottles and cans, fluorescent light bulbs of all shapes and sizes, computer monitors and equipment, televisions, and Styrofoam lunch trays. Some schools provide bottle and can recycling to students and staff.
- This year was the first year Recyclemania hit the Cambridge Public Schools. Thirteen schools competed to recycle as much paper as possible over a four-month period from January to April.
- Overall, it was a huge success with a 25% increase in paper recycling at all the schools! [1]

Description:

Recycling in schools is vital to educating the residents of Worcester and increasing the recycling rate. Outreach to students is one of the best ways to pass information in a large community. Furthermore the potential for GHG emission reductions and cost savings is great. It is calculated that implementing a recycling and food waste composting program at schools would reduce municipal emissions by 7.35%.

One way to teach students about recycling is through a competition like RecycleMania. RecycleMania is a friendly competition among university recycling programs in the United States that provides students with a fun, proactive activity in waste reduction. Over a 10-week period, schools compete in different contests to see which institution can collect the largest amount of recyclables, the least amount of trash, and have the highest recycling rate. The City of Cambridge adapted Recyclemania to work within the Cambridge Public School system and saw a 25% increase in recycling.

Potential Sources of Funding:

- MassDEP

Next Steps:

- Determine equipment and resources needed to implement a recycling program.
- Decide which products will be recycled.
- Draft an implementation plan.
- Create a plan to get students excited.
- Begin recycling and record the amount of recyclables and trash.

[1] http://www.cambridgema.gov/theworks/departments/recycle/schools.html

Other Waste Reduction Suggestions

Municipal Office Pilot and Business Outreach

As suggested in this section, outreach to the businesses in Worcester and encouraging recycling has the potential to drastically reduce the city's greenhouse gas emissions. To lead by example, Worcester should implement a pilot program in municipal offices. Some municipal offices are located in buildings that are privately owned and operated where recycling is not an option. **Though Massachusetts bans certain recyclable materials from going to a landfill or incinerator, thus making recycling mandatory, not all businesses comply with this law.** Since other businesses in Worcester are in similar situations where their buildings do not provide the option to recycle, they will be able to learn from the barriers found and the successes of municipal offices implementing recycling programs. Options include setting up a recycling pickup independent of the building, encouraging the building operators to set up a recycling program and alerting them to the state recycling requirement, designating a system for collecting recycling and bringing it to the Ballard Street Recycling Center, or setting up an agreement with the city-wide municipal trash and recycling program.

Recycle Bins at City Hall and Downtown

To show the City's commitment to recycling, recycling containers should be installed next to trash cans inside of City Hall and in the outdoor downtown area. This will show people walking through downtown that Worcester cares about protecting the environment where they live and work. It may also motivate people to recycle in their own homes, knowing that their local government is putting in the effort to do so.

Recycling at Events

Similar to placing recycling containers in City Hall and downtown, is the idea of providing the opportunity for people to recycle at City-sponsored events. This provides a leadership example for residents and lets them know that their city places importance on recycling. In 2005, the City received a DEP grant that provided event-type recycling containers that have been used at City-sponsored events at various parks. It is important to have these recycling containers visible at every City event without exception.

Buy Recycled Policy

The City currently has a "Buy Recycled" policy that goes out with all of its RFPs. This policy states that preference should be given to products containing recycled materials provided that the cost does not exceed 10% more than the cost of the same "new" product. However, Purchasing Director John Orrell states that he "can think of no bidder that has ever taken advantage of it". The City should enhance this current policy to make it more prominent, perhaps requiring the proposal of products that use recycled materials *and* those that do not, particularly with products like paper. Having a strong "buy recycled" policy supports the demand for recycling.

3.5 Green Space

"With only an estimated 15% open space remaining in the City, local regulatory methods of resource protection have been put into place to "slow the tide" of degradation and maintain and improve the quality of its natural resources...No urban area can expect to prosper in the long run unless economic growth is coupled with an ongoing effort to protect, preserve, and enhance the natural environment and the recreational facilities which make it a unique and desirable place in which to live and work."

Excerpt from Worcester's Open Space Plan 2005

What Are Urban Heat Islands?[1]

On hot summer days, cities can be up to 8° Fahrenheit hotter than their suburban and rural surroundings. This phenomenon occurs because urban development results in large amounts of paved and dark colored surfaces like roofs, roads, and parking lots that absorb, rather than reflect, the sun's heat, causing the surface and ambient air temperatures to rise.[2]

Why Should Cities Care About Urban Heat Islands?[3]

The Urban Heat Island (UHI) Effect can adversely impact a city's public health, air quality, energy demand, and infrastructure costs.

Risks To Public Health: The UHI Effect prolongs and intensifies heat waves in cities, making residents and workers uncomfortable and putting them at increased risk for heat exhaustion and heat stroke. In addition, high concentrations of ground level ozone aggravate respiratory problems such as asthma, putting children and the elderly at particular risk.

Poor Air Quality: Hotter air in cities increases both the frequency and intensity of ground-level ozone (the main ingredient in smog) and can push metropolitan areas out of compliance with federal air quality standards. Smog is formed when air pollutants such as nitrogen oxides (NO_X) and Volatile Organic Compounds (VOCs) are mixed with sunlight and heat. The rate of this chemical reaction increases when temperatures exceed 7° Fahrenheit.

High Energy Use: Hotter temperatures increase demand for air conditioning, increasing energy use when demand is already high. This in turn contributes to power shortages and raises energy expenditures at a time when energy costs are at their highest.

Global Warming: Global warming is in large part caused by the burning of fossil fuels to produce electricity for heating and cooling buildings. Urban Heat Islands contribute to global warming by increasing the demand for electricity to cool our buildings. Depending on the fuel mix used in producing electricity in

Hot Facts[4]

- Cities can be 5-10° F warmer than surrounding countryside on hot days.
- 1/6th of total electricity consumed in the U.S. is used for cooling, costing $40 billion per year.

your region, each kilowatt hour of electricity consumed can produce up to 2.3 pounds of carbon dioxide (CO2), the main greenhouse gas contributing to global warming.

The good news is that there are simple ways to reduce heat gain in cities, thus reducing the risk of poor air quality and public health, high energy use, and increased greenhouse gas emissions. Many of these UHI mitigation strategies also help solve other urban problems.

1 Cool Roofs[5]

Conventional dark-colored, low-sloped roofs reflect between 10-20% of incoming solar radiation, converting the remainder into heat that is absorbed by the roof. Much of this heat is then transferred into the building, increasing demand for air conditioning. On hot days, conventional roofing materials can be 50-60° Fahrenheit hotter than cool roofing alternatives.

Case Study: Chicago has installed a 32,000 square-foot roof-top garden at City Hall. Completed in spring 2001, this high profile demonstration project covers half of the roof with native grasses, shrubs, and trees.

Before installation, rooftop temperatures commonly measured 110° F when the surrounding ambient air was only 75°F. The city is monitoring rooftop temperatures and energy savings to assess the results of the project.[6]

Cool Roof Strategies

- Use Reflective Roofing Materials.

  Real Results: An elementary school in Alexandria VA replaced a typical black roof with a reflective roofing system. Energy costs for the school dropped from an average of $121,000 to $90,000 per year.[6a]

- Green Roofs With Vegetation or Roof-Top Gardens: Planting vegetation on a roof cools it significantly, while combining energy savings with aesthetic and ecological goals. Common in Western Europe, there are many different types of technologies that will allow the installation of up to 18 inches of soil and planting of no-maintenance vegetation on a roof.

2. Lighten Streets and Cool Parking Lots[7]

Streets and parking lots account for the majority of paved surfaces in urban areas. Almost all streets and parking lots are constructed using black asphalt, which greatly contributes to the Urban Heat Island Effect. Dark colored pavements can get up to 40° Fahrenheit hotter than the surrounding air.

Cool Paving Strategies

- Use Reflective or Other Cool Paving Materials: Construct, replace, or reconstruct roads and parking lots with reflective or cool paving materials like portland and flyash cement concrete, porous concrete, chip-seals, turf-

block or porous pavers, and light-colored asphalt emulsion sealcoats.[8] Pavement engineering studies have demonstrated that increasing pavement reflectivity can lower pavement surface and ambient air temperatures by increasing the percentage of solar radiation that is bounced back into the atmosphere.

- Shade Parking Lots: Planting shade trees in hot spots like parking lots can reduce their surface temperatures and the temperatures inside parked cars. Cool parking lots not only help reduce ambient air temperatures, but also air quality problems. Studies have demonstrated that increasing tree cover in parking lots from 8% to 50% reduces evaporation of hydrocarbons from car fuel tanks and the emissions of NO_X emissions from car start-ups.[9]

3. Green Your Community[10]

Many scientific studies confirm what we all already know from experience: trees and other vegetation make our communities cooler. Studies have found that neighborhoods with plenty of mature trees can be up to 7° cooler than treeless areas nearby.[11] Green environments do this by transpiring water into the air and by shading heat-absorbing surfaces.

Green Community Strategies

- Strategically Select and Site Trees: Trees that are placed on the west-, northwest-, and east-facing sides of buildings can significantly reduce cooling costs for a typical home or low-rise building during peak summer demand. Planting deciduous, rather than evergreen, trees will shade buildings in the summer while allowing the sun to warm them in the winter.

  Scientific Studies: Simulations of energy-saving benefits for Sacramento and Phoenix found that 3 mature trees around homes cut annual air conditioning demand by 25 to 40%.[12]

- Preserve and Plant More Trees: Preserving and increasing urban tree canopies throughout the community have been demonstrated to decrease summer-time electric bills.

  Real Results: Florida Power & Light, in conjunction with Miami-Dade County's Cool Communities Program, studied 20 Miami and Ft. Lauderdale neighborhoods and determined that residents in neighborhoods with more than 20% tree canopy coverage had summer electric bills 8% to 12% lower than neighborhoods with less coverage.[13]

- De-pave School Yards: Replacing asphalt playgrounds with green spaces provides children with interesting, safe, and cooler places to play at school.

  Case Study: Los Angeles is eliminating nearly 2 million square meters of pavement at local schools. This "de-paving" project is part of a wider effort of the Trans-Agency Resources for Environmental and Economic Sustainability (TREES) coalition, which includes an extensive strategic tree planting program.[14]

Good Trees - Bad Trees[14]

When it comes to air quality, not all trees are created equal. Some trees, such as weeping willow and eucalyptus, emit volatile organic compounds (VOCs) that combine with nitrogen oxides (NO_X) to form smog. Other trees, such as ash and maple, are very low emitters. These trees are good candidates for improving air quality because of their ability to filter and sequester pollutants such as particulate matter and carbon dioxide (CO_2). When planting trees, other considerations include the trees climate needs and species diversity.

Co-Benefits of Mitigating the UHI Effect

Besides reducing air pollution, energy demand, and greenhouse gas emissions, taking steps to mitigate the Urban

Heat Island Effect by "Greening Our Community" also has many co-benefits.

Youth leaders for the YouthGROW Program

Increased vegetation can help reduce soil erosion and sewage overflows. In September 2006, the EPA fined the City of Worcester $125,000 for violations of the federal Clean Water Act resulting from sewage overflows from the City's sanitary sewer collection system. According to the EPA, the City's sanitary sewage system has overflowed at least 70 times in the last five years.[14a] Tree planting can be a part of the solution to avoid this problem in the future. The City should develop a more comprehensive tree management program.

Community Gardens

The Regional Environmental Council, through the UGROW program, supports 22 existing community gardens composed of over 250 gardeners, and has been supporting gardens for 13 years.[15] Throughout the years, the REC has helped residents to find space for gardening and provided groups with compost, soil testing, organic seedlings & seeds, and technical assistance. Their work with community gardens helps to connect neighbors and people from all ages, involving neighborhood groups, schools, youth, senior citizens, and artists. According to the City's 2005 Open Space Plan "The Community Gardens are a public-private-partnership and receive assistance from the Regional Environmental Council, the Department of Public Works, and the Worcester Housing Authority." Two of the objectives in the Open Space Plan concern community gardens. "Objective I-6: To successfully transfer significant parcels of open space, that can be preserved as conservation land or utilized as community gardens, to the Worcester Conservation Commission. Objective I-7: To promote community gardens and identify parcels for use. Also encourage community groups to maintain them." The City can continue supporting community gardens by putting these objectives into action.

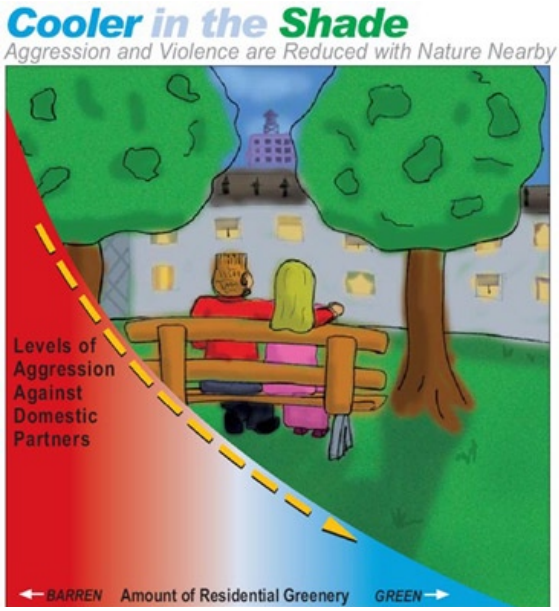
Worcester's youth harvests locally grown produce

YouthGROW (Youth Growing and Raising Organics in Worcester)

The second part of the REC's UGROW program is their YouthGROW program. The YouthGROW program is an active partnership with youth to address issues of hunger, sustainable food systems, environmental justice, and community empowerment.[16] The program has run for four years with tremendous success and has grown so much that Worcester youth ages 14-16 must apply and be selected to participate. Two years ago the youth even started a business making and selling sofrito and pesto. In YouthGROW every person's ideas are taken seriously, no matter what their age. The youth help determine what their goals are and how the program should be run. The YouthGROW program aims to connect kids with their food sources, but is also boosts their confidence, gives them a sense of responsibility and purpose, and unifies them with their surroundings.

The following information, text, and graphics are from University of Illinois at Urbana-Champaign: Landscape and Human Health Laboratory.[17]

Trees Linked with Less Domestic Violence in the Inner City

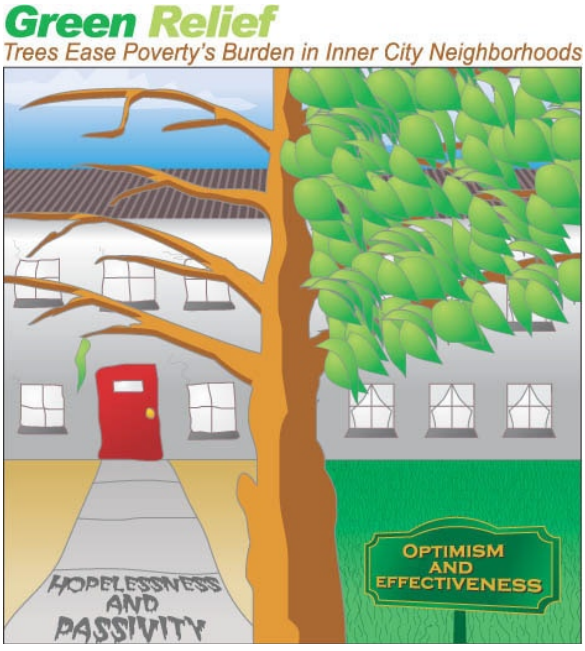


In a study conducted in a Chicago public housing development, women who lived in apartment buildings with trees and greenery immediately outside reported committing fewer aggressive and violent acts against their partners in the preceding year than those living in barren but otherwise identical buildings. In addition, the women in greener surroundings reported using a smaller range of aggressive tactics during their lifetime against their partner.

Vegetation May Cut Crime in the Inner City

In a 2001 study in one Chicago public housing development, there were dramatically fewer occurrences of crime against both people and property in apartment buildings surrounded by trees and greenery than in nearby identical apartments that were surrounded by barren land. In fact, compared with buildings that had little or no vegetation, buildings with high levels of greenery had 48 percent fewer property crimes and 56 percent fewer violent crimes. Even modest amounts of greenery were associated with lower crime rates. The greener the surroundings, the fewer the number of crimes that occurred.

Greenery lowers crime through several mechanisms. First, greenery helps people to relax and renew, reducing aggression. Second, green spaces bring people together outdoors, increasing surveillance and discouraging criminals. Relatedly, the green and groomed appearance of an apartment building is a cue to criminals that owners and residents care about a property and watch over it and each other.

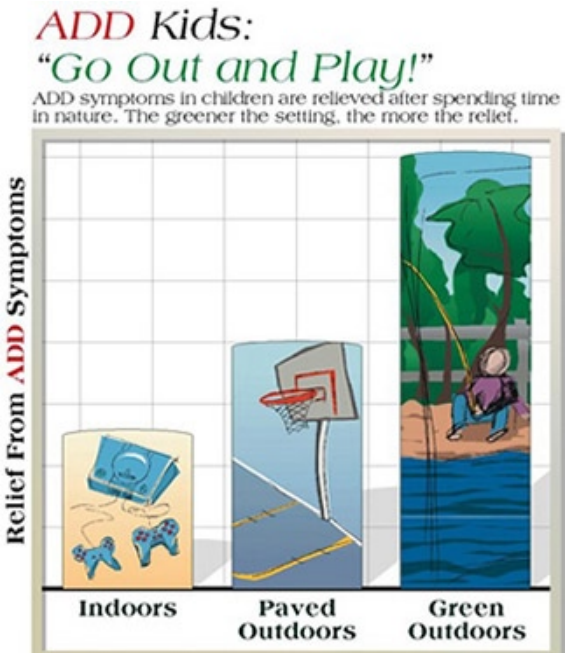


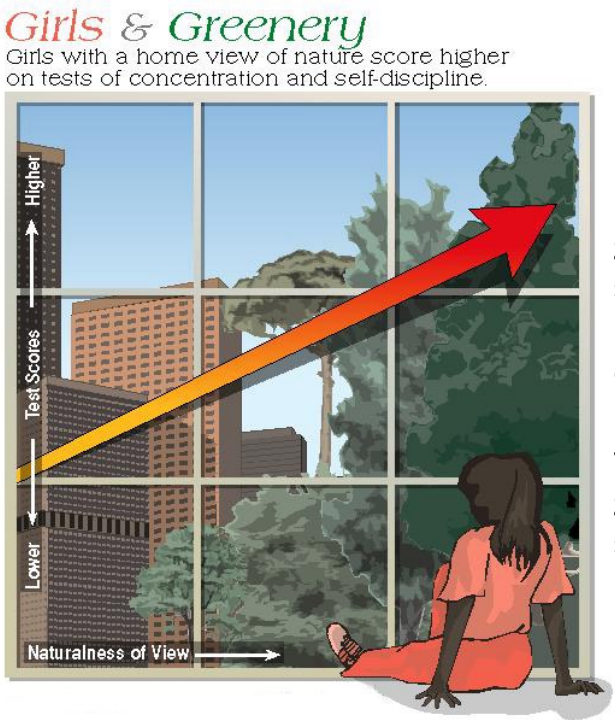
Adding Trees Makes Life More Manageable

In a study conducted in a Chicago public housing development, women who lived in apartment buildings with trees and greenery immediately outside reported greater effectiveness and less procrastination in dealing with their major life issues than those living in barren but otherwise identical buildings. In addition, the women in greener surroundings found their problems to be less difficult and of shorter duration. Thus it seems that trees help poor inner city residents cope better with the demands of living in poverty, feel more hopeful about the future, and manage their most important problems more effectively.

Green Play Settings Reduce ADHD Symptoms

Two surveys of parents of children with Attention-Deficit/Hyperactivity Disorder have shown that performing activities in green settings can reduce the symptoms of AD/HD. In an initial, Midwestern-based study, parents were more likely to nominate activities that typically occur in outdoor green settings as being best for their child's symptoms and those that typically occur in indoor or non-green outdoor areas as worst. Also, parents rated their child's symptoms as better on average after activities that occur in green settings than after activities in non-green settings. In the subsequent, nation-wide study, activities such as reading or playing sports were reported as improving children's symptoms more when performed in outdoor green settings than in non-green settings.





Views of Greenery Help Girls Succeed

In a study conducted in a Chicago public housing development, girls who lived in apartments with greener, more natural views scored better on tests of self-discipline than those living in more barren but otherwise identical housing. The study tested children on three component abilities of self-discipline: concentration, inhibition of impulsive behavior, and delay of gratification. Girls with green views scored higher on average than girls with less green views on all three tests. Boys showed no link between test scores and the amount of nature near home.

Where Trees are Planted, Communities Grow

Residential common areas with trees and other greenery help to build strong neighborhoods. When the spaces next to residences are green, they are both more attractive and more comfortable, drawing people to them. Such settings support frequent, friendly interaction among neighbors - the foundation of neighborhood social ties. These ties are the heart of a neighborhood's strength, encouraging neighbors to help and protect each other. Sharing resources with and depending upon neighbors may be especially crucial to impoverished inner-city families, so it is especially important to plant and maintain trees in such neighborhoods.

3.6 Outreach and Education

It is important to publicize Worcester's commitment and actions to reduce greenhouse gas emissions to encourage businesses, organizations, and residents in the larger community to reduce their GHG emissions as well. Keeping the community informed is vital because it lets people know about the issue at hand, shows that the city is taking action, and tells residents how they can help.

Maintain Energy and Climate Information on the City Website

One cost-friendly way of reaching out to the community is through the City's website. Currently, a section of the website is dedicated to the Energy Task Force and Worcester's efforts to reduce greenhouse gas emissions. This site should continually be maintained and improved. Knowing that others are taking action, especially an important institution like the local government, is often a catalyst for people and organizations to do their part. To visit the ETF website go to http://ci.worcester.ma.us and click on the Clean and Green logo.

Collaborate with Local Organizations

A COMMON SYMBOL OR LOGO CAN HELP UNIFY AN OUTREACH MESSAGE

It is important to join efforts with organizations working on energy and climate change issues in Worcester to create a unified outreach message. Some of these organizations include, Clean Water Fund, Mass Audubon, MA Interfaith Power & Light, and the Regional Environmental Council. Joining efforts creates a momentum that neither the city nor a single organization could create on its own; it creates publicity and a greater sense of community, which can lead to better reduction strategies and less emissions.

Promote "Green Homes" Construction and Renovation

The City should develop a plan for an outreach and education campaign targeting homeowners and builders. The plan should draw on the successful experiences of Worcester's Community Development Corporations, including East Side CDC, Oak Hill CDC, Main South CDC, and Worcester Common Ground (WCG). All of these agencies have constructed and/or retrofitted affordable housing to ENERGY STAR® standards, and have staff experienced in energy efficient construction techniques. The housing units completed in 2004 by WCG scored 90 points on the EPA Energy Star Rating Program. This represents over 30% greater efficiency than that required by the building code, according to National Grid.[1] In addition, the Main South CDC has begun construction of 10 new homes that will include solar electricity panels to satisfy approximately two-thirds of the homeowners' electricity needs.

The outreach and education campaign should also incorporate information from the Green Building Council and their Leadership in Energy and Environmental Design (LEED) Green Building Rating System™. LEED is the

nationally accepted benchmark for the design, construction, and operation of high performance green buildings. The LEED rating system for commercial buildings began in 1998, and now the LEED for Homes program is currently being developed by the USGBC with input from local and national stakeholder groups. This is a voluntary initiative promoting the transformation of the mainstream home building industry towards more sustainable practices. LEED Homes will provide a much-needed tool for homebuilders, homeowners, and local governments for building environmentally sound, healthy, and resource-efficient places to live. Worcester can help to advertise this new program and encourage home-builders to use LEED Homes as a resource for efficient building design and construction.

Get the Schools Involved

Reaching out to students is one of the most effective tactics for disseminating information. Not only are you teaching children at a young age, they often in turn relay that information to parents.

One school in Amherst, MA has developed the Wildwood School's Green Team, which consists of five mothers working towards strategies that both educate children and protect the environment. Their work has involved a composting program in school lunchrooms and campaigning for the schools to purchase recycled paper. They are currently working to reduce school bus idling in front of schools at drop-off and pick-up. They are looking into grants to reduce diesel emissions, extended exposure to which has been linked to asthma and lung cancer.[2]

Clean Energy Choice® Competition Between Schools

The City and School Department could organize a Clean Energy Choice® competition within Worcester Public Schools. In this competition, students would receive Clean Energy Choice® sign-up forms and information to bring home. The school with the highest percentage of forms (or maybe a certain number by a certain date) returned and successfully processed would win an award and prize related to clean energy (such as a solar panel, solar lighting, etc.). This must be done in a sensitive way, not punishing (or embarrassing) kids whose parents do not sign up. WPS could distribute Clean Energy Choice® sign-up forms and information supplied by Worcester's Energy Manager to the students and schools involved (could be done within a school by grade, between the same grade in many schools, or school vs. school, etc.). Information for teachers should also be provided to ensure that they are properly equipped to present the material and handle questions. Teachers would collect the Clean Energy Choice forms, track the number of forms received, and turn them over to Worcester's Energy Manager. This could be incorporated into the science curriculum on renewable energy.

Renewable Energy and Energy Efficiency Curriculum Development

The Massachusetts Department of Education's Science and Technology/Engineering Curriculum Framework includes many learning standards which can be met utilizing curriculum materials that focus on the use of energy resources and global warming. The Energy Task Force, in partnership with the Energy Manager can work with WPS to provide access for educators to curriculum materials and resources that can be inte-

grated into existing elementary, middle school, and high school academic programs, club activities, and after school programs. There are a variety of free curriculum materials for teaching about energy. There are also many professional development workshops on the topic. Massachusetts Technology Collaborative offers a guide to relieve the difficulty teachers have had finding outstanding materials about solar energy, wind power, fuel cells, and other renewable energy topics, highlighting those educational materials that are aligned with the Massachusetts Curriculum Frameworks. It describes and assesses the most useful materials available. http://www.masstech.org/cleanenergy/curriculum/about.htm

Create an Energy Theme for the Annual School Projects Fair

Every May WPS hold a joint Projects Fair. The Energy Task Force proposes that the theme of the 2007 fair be renewable energy and energy efficiency.

Collaborate with Local Universities

There are 12 colleges and universities within the Greater Worcester area, representing a great collaboration potential. Ties have already been made with some of Worcester's major colleges and universities, namely Clark University, Worcester Polytechnic Institute (WPI), Holy Cross, Worcester State College (WSC), Assumption College, and UMASS Medical School. Rob Krueger, Assistant Professor and Director of the Worcester Community Project Center in the Interdisciplinary and Global Studies Division at WPI, serves on the Energy Task Force and has advised students conducting research related to Worcester's GHG emission reductions and renewable energy use. Through collaboration with Clean Water Fund of Boston, REC of Worcester, and Carissa Williams, DBA of Worcester, Clark University has set up a Sustainability Task Force, a class for measuring the campus GHG emissions, and a system for allowing students to support renewable energy. In October 2006, Clark University made their first semi-annual purchase of Renewable Energy Certificates from Mass Energy Consumer's Alliance. The purchase totaled $10,300 with a $10,300 match from MTC being put into the City of Worcester's clean energy fund. The City should continue to involve faculty, students, and administration at Clark, WPI, Holy Cross, and WSC, while developing contacts at Assumption and UMASS Medical School. The goals of this collaboration should be to educate leaders about 1) the feasibility, costs, and benefits of renewable energy procurement, 2) the university's energy choices and potential for renewable generation and/or Clean Energy Choice^{SM} participation, and 3) the benefits and need for creating a sustainable university. The Energy Manager can educate these institutions and serve as a resource for them on energy issues, thus creating a stronger bond between the City and the Colleges and Universities and supporting their symbiotic relationship.

Media Campaign

A host of options exist for outreach to the community through media. Some include:

- An outdoor banner outside City Hall to declare Worcester's education campaign and encourage residents to learn more

- Anti-idling street signs at major student pick-up areas
- Conduct direct outreach through partner organizations' constituents: via email/listserve, mailings, phone canvas, door-to-door canvas, and presentations
- Create and disperse bilingual (Spanish/English) educational brochures and website
- Media coverage and advertising: print advertisements/PSAs, newspaper coverage, flyer insert in Worcester Magazine or Telegram & Gazette, radio and television shows, news coverage or PSAs
- Potential billboard space and time donation
- The City's Energy Task Force Website - http://ci.worcester.ma.us and click on the Clean and Green logo

Hold an Energy Fair

This should be a highly informative and fun event that includes many community partners, vendors, and representatives. The main focus of the event should be to engage the entire community in learning about the City's GHG emission reduction initiative and ways for individuals and businesses to take an active role in helping to meet Worcester's GHG reduction goals. The fair would provide information about businesses, professional firms, organizations, and individuals offering sustainable energy products and services to Worcester residents and businesses and could be held on the City Common. Examples of vendors include green-building contractors, solar specialists, architects, energy conservation specialists, energy star representatives, clean energy suppliers, business consultants, environmental educators, and many other useful resources.

Participate in the Annual Earth Day Fair

Every year the City of Worcester partners with the Regional Environmental Council to sponsor the city-wide Earth Day clean-ups. The REC also sponsors an Earth Day Fair around the same time. Last year the REC partnered with the EcoTarium to put on a larger event. The City should participate in the annual Earth Day fair and distribute information about the Climate Action Plan, Worcester's energy goals and actions, and other environmental initiatives, such as the mercury take-back campaign, curb-side recycling, and hazardous waste collection. By having a presence and distributing brochures at the Earth Day Fair, the City can help residents to understand how they can take an active role in lowering their own energy emissions output.

Promote an Employee Take Public Transportation, Bike, or Walk to Work Week

Once a year some City officials take part in an Elected Officials take public transportation to work day. The City could expand on this idea to promote a week of taking public transportation, biking, or walking to work. Incentives could be offered by department heads for City employees, and the City could also issue a challenge to all businesses and employees who work in Worcester.

[1] Newton Climate Action Plan, February 2005.
[2] Amherst Climate Action Plan, September 2005.

3.7 Proposed and Completed Emission Reductions Compared with Municipal Reduction Target

It is important to acknowledge that Worcester's emissions and energy use are currently growing, and that calling for an actual reduction is a big step. Any of the recommended actions taken will help to slow the growth. The table below outlines the major emission reduction measures and their contribution to reaching the 11% municipal target. Waste reduction measures account for the largest portion of greenhouse gas emission reductions, representing a reduction of 42.74% - well beyond the target of 11%. Table 6 outlines the major proposed community reduction measures for a total reduction in community greenhouse gas emissions of 1.92%.

Municipal Measures applied toward municipal target	**% of emissions reduced****	**Cost Savings ($/yr)**	**eCO_2 Reductions (tons/yr)**	**Renewable Energy Used (kWh)**
Building Upgrades completed since 2002	*0.14%*	$99,822	285	
Pearl/Elm Garage Lighting Upgrade	*0.04%*	$31,387	89	
Upgrade 200 Exit Signs	*0.01%*	$7,972	23	
Energy Efficiency Total	*0.20%*	***$139,181***	***397***	
Solar Electricity @ Voc School	*0.00%*	$390	1	3,000
Hydro-Power @ Water Filtration	*0.14%*	$63,072	292	788,400
Solar Hot Water @ Water Filtration	*0.00%*	$1,456	7	18,194
Solar Heat @ UBWPAD	*0.00%*	$321	1	
Wind Turbine @ new North High	*0.07%*	$52,000	148	400,000
Solar Hot Water @ Schools	*0.00%*	$2,365	7	18,194
Solar Heat @ Schools	*0.00%*	$341	1	
$25,000 REC Purchase	*0.15%*	-	309	833,000
Renewable Energy Total	*0.30%*	***$119,945***	***610***	***2,060,788*** *(3.39% of municipal kWh consumption)**
Increased Fuel Efficiency	*0.11%*	$36,738	224	
B-20 Pilot	*0.00%*	0	4	
Enable 5 minute shut-off	*0.33%*	$130,151	671	
Transportation / Vehicle Fleet Total	*0.45%*	***$166,889***	***899***	
Recycle at Schools	*7.35%*	$152,376	14,813	
Increase Curb side Recycling	*15.09%*	$312,776	30,407	
Methane Capture	*20.30%*	$1,364,184	40,908	27,283,680
Waste and Recycling	*42.74%*	***$465,152***	***86,128***	***27,283,680***
TOTAL	*43.69%*	**$891,167**	**88,034**	**29,344,468** (48.26% of municipal kWh consumption)

* Municipal electricity consumption of 60,799,392 kWh/year

** Annual municipal emissions equals 201,538 tons/yr (11% = 22,169 tons/yr)

Table 5. *Contribution of Municipal Reduction Measures to Reaching the Municpal Target*

Community Measures applied toward community target	**% of emissions reduced***	**Cost Savings ($/yr)**	**eCO_2 Reductions (tons/yr)**
Change A Light	.12%	$1,042,376	2,424
Energy Efficiency Total	***.12%***	***$1,042,376***	***2,424***
Clean Energy Choice	.82%	$324,124	16,455
Renewable Energy Total	***.82%***	***$324,124***	***16,455***
426 people take public transport, bike, or walk to work	.12%	$531,316	2,369
426 people telecommute one day per week	.02%	$102,249	456
Increase Carpooling	.24%	$1,064,329	4,742
Transportation / Vehicle Fleet Total	***.38%***	***$1,697,894***	***7,567***
Encourage large complex recycling	.60%	Unknown	12,048
Waste and Recycling	***.60%***		***12,048***
TOTAL	**1.92%**	**$3,064,394**	**38,494**

*Community GHG emissions of 2,209,185 - 201,538 (municipal emissions) = 2,007,647 tons/year

Table 6. *Contribution of Community Reduction Measures To Reaching the Community Target*

Worcester's commitment to environmental and social progress will continue beyond the municipal 2010 11% target, as will the efforts of the Energy Task Force and the City to provide a healthier, safer, and more responsible energy future for the entire community.

Section Four: Implementation and Monitoring

The Energy Task Force has played a central role in the development of this document. The process of creating it has demonstrated how individuals from various sectors of the community and municipal departments can effectively come together and organize around a clear and common goal. This same spirit of dedication and commitment will be required for the next phases of continued development, implementation, monitoring, evaluation, and problem-solving.

The ETF should evolve into an advisory committee and remain the central body to oversee and advance the strategies outlined in the Climate Action Plan. It is proposed that membership of this group expand to include more members of the business community and local Universities/Colleges operations. As previously mentioned, the success of this Plan will require participation from all sectors of the community at large, including the residents of Worcester. The ETF recommends including ***at least*** the following representatives:

- Five from different municipal departments;
- One each from Assumption College, Clark University, Holy Cross, Worcester Polytech Institute, Worcester State College;
- One each from National Grid and NSTAR and WRTA;
- Three from the residential population and community groups;
- Two from the local business community.

The Energy Manager (EEM) should continue to facilitate the meetings and work of the Energy Task Force. Without a full-time EEM the task force will lose its momentum and guidance, and emission reduction measures may not be implemented properly, may lack funding, or may not be implemented at all.

4.1 Implementation Strategy

The Energy Task Force should meet on a bi-monthly basis to support continued development, implementation, evaluation and progress towards the goals in the Climate Action Plan, with subcommittees meeting as needed. In addition to the three current sub-committees on transportation, energy efficiency, and renewable energy, sub-committees may be formed to support outreach and education, funding, data collection, solid waste, and green space. Individual members can be assigned coordinating roles depending upon the relevance of the strategy to the particular sector that member represents. Members of the community at large will be engaged in the implementation of the individual measures through the outreach methods detailed in Section 3.5 Outreach and Education.

Updates on individual and sub-committee efforts at regular Energy Task Force meetings will serve

to ensure that development and implementation continues to move forward. As the Climate Action Plan is a living document, additional strategies and measures can be created and incorporated into the plan on an annual basis.

4.1.1 Environmental Justice Considerations

Opportunities to counter climate change in the community abound. There is a range of choices in the actions to be taken, and some may have different impacts on different social groups. To ensure equity and to sustain community support for the actions, it is important to give attention to the possibility of unintended effects. For example, energy efficiency upgrades in a building may involve initial costs that are recouped over time. Lower-income households may not be able to afford the initial investment.

To protect against inequitable outcomes, the implementation process should be inclusive and provide for genuine dialogue. Representatives from organizations serving low-income populations should be involved with the Energy Task Force and, whenever possible, the public should be able to comment on residential energy outreach and suggestions. Reaching out to a wide segment of the community and conducting the process openly will foster better ideas, greater commitment, and more effective action. For example, identifying obstacles that low-income households face in implementing energy efficiency measures can and should lead to solutions.

4.2 Monitoring Strategy

The Climate Action Plan can be reviewed on an annual basis in the form of an annual Progress Report and Work plan. This report should include updates on existing measures, successes from the past year, obstacles, and goals for the coming year. Emphasis should be placed on identifying the specific funding and support needs of City departments and Worcester community members in order to achieve emission reduction goals in the coming year. Reports on specific measures and an overall forecast as to how the reduction target is being met should be produced utilizing the ICLEI software and included in the annual revision.

As individual goals and measures are met, the Energy Task Force can assist members of the Worcester community and City staff in:

- Assessing which measure(s) will be acted upon next;
- Evaluating progress and developing new municipal and community reduction targets and goals;
- Assessing what resources and support are needed to support members of the community and City staff in implementing Plan goals;
- Assisting in efforts to obtain needed resources and support;
- Enlisting citizen support for implementing Plan goals.

4.3 Sources of Funding

Given that some financial investments are necessary to implementing the Climate Action Plan, efforts should be made by members of the ETF to locate and pursue funding sources or to recruit and support a team of volunteers to help in this work. For a list of potential funding opportunities see Appendix F.

4.4 Ongoing Data Collection

To sustain energy reduction and climate change mitigation efforts, a program is needed to monitor trends in community-wide and municipal GHG emissions in the areas of energy, transportation, and waste. It is relatively easy to collect some community-wide and municipal data on an annual basis. The following data could be collected:

Total Community Data Collection

Sector	Parameter (suggested units)	Source
Residential	Natural Gas (therms)	NSTAR
Residential	Light Fuel Oil (gallons)	Census; EIA (Energy Information Asc.)
Residential	Electricity (kWh)	National Grid
Residential	# of Households	Census
Residential	City Population	Census
Commercial/Industrial	Natural Gas (therms)	NSTAR
Commercial/Industrial	Light Fuel Oil (gallons)	EIA
Commercial/Industrial	Electricity (kWh)	National Grid
Commercial/Industrial	# of Employees	Census
Commercial/Industrial	# of Establishments	
Commercial/Industrial	Area of floor space (sq. ft.)	
Municipal	Natural Gas (therms)	Select Energy; UBWPAD; Water Filtration; Airport
Municipal	Light Fuel Oil (gallons)	Peterson Oil**; UBWPAD; Water Filtration; Airport
Municipal	Electricity (kWh)	Select Energy; National Grid; UBW-PAD; Water Filtration; Airport
Municipal	# of Employees	Census
Transportation	Personal Vehicles (VMT)	CMRPC; Mass Highway
Transportation	Bus - WRTA (VMT)	WRTA
Transportation	Rail - MBTA (VMT)	MBTA
Waste	Trash (tons)	DPW; Wheelabrator; Schools
Waste	Compost (cubic yds. or tons)	DPW
Waste	Recycling (tons)	DPW

**Data may need to be collected from both Peterson Oil and Dennis K. Burke

Municipal Operations Data Collection

Sector	**Department**	**Parameter** (suggested units)	**Source**
Buildings	Schools	Natural Gas (therms)	Select Energy
Buildings	Schools	Light Fuel Oil (gallons)	School Dept.
Buildings	Schools	Electricity (kWh)	Select Energy
Buildings	City Hall	Natural Gas (therms)	Select Energy
Buildings	City Hall	Light Fuel Oil (gallons)	DPW
Buildings	City Hall	Electricity (kWh)	Select Energy
Buildings	Sewage Treatment	Natural Gas (therms)	UBWPAD
Buildings	Sewage Treatment	Light Fuel Oil (gallons)	UBWPAD
Buildings	Sewage Treatment	Electricity (kWh)	UBWPAD
Buildings	Water Filtration	Natural Gas (therms)	Director WF plant
Buildings	Water Filtration	Light Fuel Oil (gallons)	Director WF plant
Buildings	Water Filtration	Electricity (kWh)	Director WF plant
Buildings	Fire	Natural Gas (therms)	Select Energy
Buildings	Fire	Light Fuel Oil (gallons)	Fire Dept.
Buildings	Fire	Electricity (kWh)	Select Energy
Buildings	Police	Natural Gas (therms)	Select Energy
Buildings	Police	Light Fuel Oil (gallons)	Police Dept.
Buildings	Police	Electricity (kWh)	Select Energy
Buildings	Airport	Natural Gas (therms)	Airport
Buildings	Airport	Light Fuel Oil (gallons)	Airport
Buildings	Airport	Electricity (kWh)	Airport
Buildings	Other Buildings	Natural Gas (therms)	Select Energy
Buildings	Other Buildings	Light Fuel Oil (gallons)	Purchasing Dept.
Buildings	Other Buildings	Electricity (kWh)	Select Energy
Transportation	Parks Dept. (Hope Cm.)	Diesel fuel (gallons)	DPW / Parks / Hope Cm.
Transportation	Parks Dept. (Hope Cm.)	Gasoline (gallons)	DPW / Parks / Hope Cm.
Transportation	DPW	Diesel fuel (gallons)	DPW
Transportation	DPW	Gasoline (gallons)	DPW
Transportation	Police	Diesel fuel (gallons)	Police
Transportation	Police	Gasoline (gallons)	Police
Transportation	Fire	Diesel fuel (gallons)	Fire
Transportation	Fire	Gasoline (gallons)	Fire
Transportation	Airport	Diesel fuel (gallons)	Airport
Transportation	Airport	Gasoline (gallons)	Airport
Transportation	School Buses	Diesel fuel	Durham Bus***
Transportation	Sewage Treatment	Diesel fuel (gallons)	UBWPAD
Transportation	Sewage Treatment	Gasoline (gallons)	UBWPAD
Lighting	Traffic Lights	Electricity (kWh)	Select Energy / DPW
Lighting	Street Lights	Electricity (kWh)	National Grid / DPW
Lighting	Recreational Lights	Electricity (kWh)	Select Energy / DPW

*** Durham Bus Company owns and operates the buses for Worcester Public Schools (WPS). Another company, First Student, also provides vehicles for WPS; they provide mostly vans.

Dennis K. Burke = Municipal Gasoline and Diesel Provider
DPW = Department of Public Works and Parks
Hope Cm. = Hope Cemetery - a division of Parks
Parks = Division of DPW, formerly the Parks Department
Peterson Oil = Municipal Oil, Gasoline and Diesel Provider
National Grid = Electric Company
NSTAR = Natural Gas Company
Select Energy* = Municipal electricity and natural gas provider (along with National Grid and NSTAR)
*Beginning July 1, 2006, Hess Corporation became the electricity and natural gas provider.
UBWPAD = Upper Blackstone Water Pollution Abatement District, Sewage Treatment Plant

While this chart lists only the major building categories, other buildings may also be separated out - such as individual schools, fire stations, the library, and individual office buildings. It is important to also collect cost data when collecting energy consumption data. The two are almost always available together, and both are important to the analysis of reduction measures.

It is best to collect data directly from the individual department heads of the following departments: Airport, DPW, Parks, Fire, Police, Schools, Water Filtration, as well as the regional sewage treatment plant. The accounts payable offices often keep this detailed data on record and can send it with relative ease and promptness. For a departmental organization chart, see Appendix H.

Listed below are some of the contacts at the data sources shown in the above two data collection charts.

Airport
Phil Brodeur
Worcester Regional Airport
508 799 1350
BrodeurP@ci.worcester.ma.us

Water Filtration
Bob Hoyt
Director of Water Filtration

hoytr@ci.worcester.ma.us

DPW
Bob Fiore

508 799 1430
fiorer@ci.worcester.ma.us

Select Energy
Tom Flaherty
Regional Account Executive
800 789 2213 x353
flahet@selectenergy.com

UBWPAD
Tom Walsh

508 755 1286
tkwalsh@ubwpad.com

WRTA
John Carney
General Manager
508 756 8324 x3002
jcarney@therta.com

School Department
Jeff Lassey
Director of Facilities
508 799 3151
lasseyj@worc.k12.ma.us

Parks	**Hope Cemetery**	**Police**	**Fire**
Tim Boucher	Donna M. Berrios	Gary Gemme	Joanne Murphy-Smith
Physical Plant Director	Business Administrator	Chief	Accounts Payable
(508) 799-1297		508 799 8600	508 799 1831
bouchert@ci.worcester.ma.us	berriosd@ci.worcester.ma.us		murphy-smith@ci.worcester.ma.us

To get more detailed city of Worcester community data, the consumption of electricity, natural gas, light fuel oil, gasoline, diesel, and other emission sources (if applicable) should also be collected from hospitals, universities and colleges, other large buildings (if applicable) such as commercial or industrial buildings, and businesses. This data could be collected with a voluntary reporting system administered through the City's website. Other important data to collect includes the number of households and businesses taking advantage of the energy audits offered by NSTAR (natural gas company) and National Grid (electric company). This data is available from the respective utility companies.

The methane emissions from the sewage treatment plant are not included in the original GHG emissions inventory completed in 2004. Other revisions can be made to the original 2004 inventory to make it more detailed and accurate. Suggestions for future data collection include:

- Gather more detailed commercial and residential oil data.
- Gather more detailed data on municipal trash generation, particularly in offices that are not in municipally owned buildings and thus not serviced by the City's trash and recycling collector.
- Obtain specific emissions data from Wheelabrator Incinerator to derive more accurate emission factors.
- Gather recycling data for the commercial and industrial sectors.
- Look into stationary sources of gasoline and diesel use. There are a wide variety of industrial applications of both gasoline and diesel internal combustion (IC) engines such as aerial lifts, fork lifts, mobile refrigeration units, generators, pumps, industrial sweepers/scrubbers, material handling equipment (such as conveyors), and portable well-drilling equipment (Torrie Smith Associates 2004, creator of the CACPS software). This may be a source of emissions in Worcester that is not currently accounted for.

In addition, it is important to compile the results of actions taken within the community. A reporting format could be used based on forms ICLEI has developed for local governments. The City could serve as a repository for these reports. With this information, the City could produce an annual report on trends and actions. The report would provide a way for stakeholders to put their actions into context and for the community to judge the effectiveness of the effort.

Section Five: Conclusions and Next Steps

Increasing levels of man-made greenhouse gas emissions are contributing to climate change and global warming. This presents a need to reduce GHG emissions. Local governments are well-positioned to implement emission reduction strategies. The first step to making reductions is to join the Cities for Climate Protection (CCP) campaign and take an inventory of the GHG emissions in the city. An initial inventory of GHG emissions in 2002 has been completed, revealing energy consumption patterns and GHG emission sources. There are many ways that Worcester should be able to reduce its GHG emissions, many of them offering co-benefits such as reduced energy expenditures, enhanced public image, and a cleaner, healthier city.

The effort to stabilize man-made greenhouse gases in the atmosphere will require a long-term commitment. The emission reduction goals that are currently being set on local, national and international levels are the starting point for an unprecedented global effort to lessen the potentially devastating impacts of an environmental problem that can affect every person on this planet. Fortunately, the human race has a tremendous capacity for innovation and adaptation. The Energy Task Force believes, and hopes, that this Climate Action Plan is the beginning of one small – but potentially important – demonstration of that capacity. Much of what happens next, and for the next few years, will depend on the willingness of all the stakeholders to make a commitment to climate protection.

The City of Worcester has begun to take steps to protect itself and its citizens from climate change and rising energy prices by passing the Cities for Climate Protection Resolution, creating an Energy Task Force, and, most recently, becoming a member of ICLEI. **The most important next steps for Worcester include adopting the Climate Action Plan and municipal reduction target, hiring a full-time Energy Manager, implementing cost-effective emission reduction measures, and creating a modern GHG emissions database.** Creative ideas and solutions are always welcome.

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Section 3.4.2

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Appendix A: Municipal Policies and Resolutions

Cities for Climate Protection Resolution: Passed October 2003

CITY OF WORCESTER

WHEREAS:	A scientific consensus has developed that Carbon Dioxide (CO2) and other greenhouse gases (ghg) released into the atmosphere have a profound effect on the Earth's climate; and
WHEREAS:	Scientific evidence, including the Third Assessment Report from the International Panel on Climate Change (IPCC) and the U.S. Global Change Research Program's (USGCRP) First National Assessment indicate that global warming has begun, with the 1990's the hottest decade in recorded history; and
WHEREAS:	More than 160 countries pledge under the United Nations Framework Convention on Climate Change to reduce its greenhouse gas emissions; and
WHEREAS:	In 2001 at the request of the Administration, the National Academy of Sciences (NAS) reviewed and confirmed the concerns of the environment and public health communities and declared global warming a real problem impacting key vulnerable populations. The NAS report also confirmed that global warming is caused in part by the actions of humankind; and
WHEREAS:	Energy consumption, specifically the burning of fossil fuels, accounts for more than 80% of U.S. greenhouse gas emissions; and
WHEREAS:	Local governments significantly influence the community's energy usage by exercising key powers over land use, transportation, construction, waste management and energy supply and management; and
WHEREAS:	Local government actions taken to reduce greenhouse gas emissions and increase energy efficiency provide multiple local benefits by decreasing air pollution, creating jobs, reducing energy expenditures, and saving money for the local government, its businesses and its residents; and
WHEREAS:	The Cities for Climate Protection Campaign, sponsored by the International Council for Local Environmental Initiatives (ICLEI) has invited the City of Worcester, Massachusetts to become a partner in the Campaign; Now, Therefore, Be It
RESOLVED:	That the City of Worcester commits to participate in the Cities for Climate Protection Campaign and, as a participant, pledges to take a leadership role in promoting public awareness about the causes and impacts of climate change. The City of Worcester will undertake the Cities for Climate Protection program 5 milestones to reduce both greenhouse gas and air pollution emissions throughout the community, specifically: • Conduct a greenhouse gas (ghg) emissions inventory and forecast to determine the source and quantity of ghg emissions in the jurisdiction; • Establish a greenhouse gas emissions reduction target; • Develop an action plan with both existing and future actions which when implemented will meet the local greenhouse gas reduction target; • Implement the action plan; and • Monitor to review progress; and be it further
RESOLVED:	That the City of Worcester requests assistance from the International Council for Local Environmental Initiatives (ICLEI) Cities for Climate Protection Campaign (CCP) as it progresses through the milestones.

In City Council October 7, 2003

Resolution adopted by a yea and nay vote of Eleven Yeas and No Nays.

Clean Energy Resolution: Passed March 2005

CITY OF WORCESTER

WHEREAS:	Electricity generation produces more harmful air pollution than any other single human activity, and the emissions caused by current methods of electricity generation trigger asthma attacks and contribute to other respiratory illnesses, heart disease and cancer, as well as contribute significantly to global warming; and
WHEREAS:	The City of Worcester stands in the path of airborne pollution from power plants, and Worcester County has received a failing grade for ozone pollution from the American Lung Association; and
WHEREAS:	Worcester County has over 67,000 adults and children with asthma, and asthma attacks can be triggered by unhealthy levels of pollution; and
WHEREAS:	The U.S. energy needs are expected to grow by 33% over the next 20 years, and clean, renewable technologies can be generated and distributed right in the U.S.; and
WHEREAS:	Clean, renewable energy resources – such as wind and solar – are constantly replenishing themselves, do not cause the buildup of global warming gases and other pollutants and, if property managed, will be available to serve our energy needs forever; and
WHEREAS:	Power plant emissions can be reduced in a cost-effective manner that enhances economic development by applying currently available energy efficiency technologies and renewable energy programs that save money, create jobs and strengthen local economies; and
WHEREAS:	The City of Worcester has joined the Cites for Climate Protection campaign and is dedicated to reducing air pollution and global warming emissions; and
WHEREAS:	Mayor Murray and City Manager O'Brien have convened an energy Task Force to research these issues of energy and pollution and to make recommendations for Worcester's wise energy use; and
WHEREAS:	A clean energy option exists for consumers in Worcester who are able to sign up for clean energy on their electric bill; Now, Therefore, Be It
RESOLVED:	That the City of Worcester, with a commitment to the health of its citizens, commit to making at least 20% of its electricity purchases come from clean, renewable sources by the year 2010, with clean energy purchases beginning in 2005 and increasing over time to meet the 2010 goal; Be It Further
RESOLVED:	That the City of Worcester shall achieve this goal by, at a minimum, purchasing enough clean energy certificates to account for 20% of its power consumption; Be It Further
RESOLVED:	That the City Council encourage the city administration to undertake further energy efficiency and conservation measures; Be it Further
RESOLVED:	That the City Council shall direct Mayor Murray's and City Manager O'Brien's Energy Task Force to investigate options for meeting the 20% by 2010 goal, including clean energy installations and possible funding opportunities; Be It Further
RESOLVED:	That the City Council encourages residents and businesses to choose the clean energy option on their electricity bill and will declare a Clean Energy Day to announce the City's commitment to 20% by 2010 and raise awareness of the clean energy option.

In City Council March 29, 2005

Resolution adopted.

A Copy. Attest:

David J. Rushford
David J. Rushford
City Clerk

Introduced in City Council by Mayor Timothy P. Murray

Energy Coordinator Resolution: Passed September 2005

C\2005SEP0917:00:50

MICHAEL V. O'BRIEN
City Manager

CITY OF WORCESTER

29 A

September 13, 2005

TO THE WORCESTER CITY COUNCIL

COUNCILORS:

I respectfully recommend the approval of the attached resolution and summary to apply for eleven thousand eight hundred and thirty seven dollars ($11,837.00) under the Clean Energy Choice Matching Grant program being administered by the Massachusetts Technology Collaborative.

I intend to utilize these funds to contract with a part-time Energy Coordinator who will analyze potential costs and economic benefits of incorporating green/clean energy technologies in new building and construction designs and capital rehabilitation projects. With these funds, and the hiring of an expert who can recommended green/clean energy alternatives to the city, I intend to seek and identify fossil fuel alternative energy consumption technologies that will reduce city costs in its new and existing buildings, and other energy conservation programs. This is a most timely endeavor given the staggering per unit increases the city faces with the projected higher energy costs this winter. It will be critical for the city to identify these new clean and green energy technologies and lower overall consumption if we are to reduce Worcester's demand on fossil fuel energy consumption. Give the amount of money spent by the city for energy commodities small reductions in those areas do amount to substantial citywide savings that will be necessary to keep the city's budget in balance. Per the City Council resolution adopted March 29, 2005, I also intend to name an ad hoc committee comprised of individuals with a range of expertise and knowledge to assist in the coordination of this both short term and long term.

I will keep City Council apprised of this initiative and will periodically report on our progress to introduce green/clean energy technologies into the city's construction and building designs and rehabilitation and our efforts to reduce energy consumption and generate costs savings through alternative energy sources.

Respectfully submitted,

Michael V. O'Brien
City Manager

OFFICE OF THE CITY MANAGER, CITY HALL, WORCESTER, MASSACHUSETTS 01608
TELEPHONE (508) 799-1175 FAX (508) 799-1208
EMAIL: citymanager@ci.worcester.ma.us

Worcester
All-America City

MICHAEL V. O'BRIEN
City Manager

CITY OF WORCESTER

TO: **Michael V. O'Brien, City Manager**

FROM: **John P. Pranckevicius, Chief Financial Officer**

DATE: **September 8, 2005**

RE: **Massachusetts Technology Collaborative**
Clean Energy Choice Matching Grants
Summary and Resolution

The Massachusetts Technology Park Corporation, "a public instrumentality of the Commonwealth of Massachusetts, doing businesses as the Massachusetts Technology Collaborative (MTC) and administrator of the Massachusetts Renewable Energy Trust (RET) has established the Clean Energy Choice (CEC) Program. The MTC will apply RET funds up to a total aggregate amount for all Massachusetts cities and towns of $1,250,000 to match a portion of customer contributions to MTC and/or payments made to suppliers under CEC, and will provide the applicable portion of the CEC Community Match to the customer's city or town to be used for eligible renewable energy projects."

The amount Worcester earns is dependent upon the number of participants who pay a premium for renewable energy through GreenUp/Clean Energy Choice. Worcester has been allocated match funds in the amount of $11,836.68 for clean energy premiums paid by Worcester residents and organizations from October 1, 2004 through June 30, 2005. The City will accumulate additional amounts each quarter and can submit an application for those amounts as soon as they are awarded—approximately 30 days after each calendar quarter ends. Because almost $12,000 was generated in a 9-month period, and assuming the participation remains the same with perhaps additional participants, the City could expect to earn between $3,000 and $4,000 each quarter.

Through the Clean Energy Program, Worcester is eligible to submit an application for the MTC funds that support eligible projects including renewable electricity generating equipment; clean energy educational materials and activities (e.g., bus rental enabling students to visit renewable energy sites/field trips); building analysis and improvements including an energy modeling study, data acquisition equipment for a solar photovoltaic system, or a solar photovoltaic system for a municipal building or school; or leverage toward funding from another renewable energy trust. There is no deadline for the application.

The City of Worcester is interested in applying for funds, in collaboration with the Regional Environmental Council (REC), to contract with an Energy Coordinator who will conduct assessments of current clean/green energy projects, determine future clean/green energy programs, and expand the City's green energy efforts through partnerships and collaborative initiatives. Through these studies, the part-time Energy Coordinator will evaluate the City's potential cost savings relating to alternative energy choices.

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Worcester
All-America City

A RESOLUTION TO FILE AND ACCEPT A MASSACHUSETTS TECHNOLOGY COLLABORATIVE CLEAN ENERGY CHOICE MATCHING GRANT THROUGH THE MASSACHUSETTS RENEWABLE ENERGY TRUST

WHEREAS: The Massachusetts Technology Collaborative (MTC) has awarded funds under the Clean Energy Choice Program (CEC) to Massachusetts cities and towns matching a portion of customer contributions to MTC and/or payments made to suppliers under the CEC Community Match; and

WHEREAS: The MTC will provide the applicable portion of the CEC Community Match to the customer's city or town to be used for eligible renewable energy projects; and

WHEREAS: Worcester has been awarded $11,836.68—the match for clean energy premiums paid by Worcester residents and organizations from October 1, 2004 through June 30, 2005; and

WHEREAS: The City will accumulate additional amounts each quarter, and there are no application deadlines; and

WHEREAS: The City of Worcester intends to submit an application to contract with an "Energy Coordinator" to conduct an assessment of current City clean energy practices and projects, review potential clean energy projects, and develop partnerships to expand the City's clean energy initiatives;

NOW, THEREFORE BE IT:

1. That the City Manager be and is hereby authorized to file and accept a grant application with the Massachusetts Technology Collaborative;

2. That the City Manager be and is hereby authorized to file information as required by the Massachusetts Technology Collaborative;

3. That the City Manager be and is hereby authorized to accept grant funds and execute contracts, and any amendments thereto, in order to carry out the terms, purposes and conditions of the Massachusetts Technology Collaborative;

4. That the City Manager be and is hereby authorized to take such other actions as are necessary to carry out the terms, purposes, and conditions of the grant administered by the Massachusetts Technology Collaborative;

5. That this resolution shall take effect upon passage.

Municipal Energy & Resource Efficiency Policy: Proposed

I. PURPOSE

A. To inform all City employees of the need to use energy and other resources efficiently in order to minimize the cost of City operations to City tax payers and to protect and preserve the natural environment and quality of life in Worcester.

II. POLICY

A. It is the policy of this the City of Worcester to continually improve the efficient use of all energy and other resources in order to insure a future with a secure and sustainable energy supply, and to apply a concerted effort toward achieving the highest possible level of energy efficiency and sustainability in all facilities and operations.

III. RESPONSIBILITIES

A. The Energy Manager shall monitor the overall energy usage for the City, including maintaining an inventory of energy use, answering questions of citizens related to energy conservation.

B. All department heads will be responsible for energy efficiency programs in their departments and agencies in accordance with these guidelines and any other possible means of increasing the level of efficiency with which energy and other resources are used.

C. All Boards, Commissions, Committees, and other organizations that utilize any municipal building for meetings, events, and the like are also responsible for adherence to this policy.

D. With the exception of a verbal warning[s], no department head, employee, commission or board member of the City of Worcester shall be subject to termination or any disciplinary action for his/her violation of this policy. Nor shall any verbal warning[s] given to a department head, employee, commission or board member of the City of Worcester be used or considered as part of any performance, salary or promotional review.

IV. GENERAL

A. Lighting

1. Except for security lighting in off-hours, all lights shall be turned off in unoccupied rooms. Normal office building hours for employees at City Hall are 8:30 AM to 5:00 PM Monday through Friday. Workers who use offices outside of normal hours should minimize use of overhead lights and will be responsible for turning off all lights when they leave the building.

2. Planned lighting maintenance will be performed including regular cleaning and timely lamp replacement. Group relamping will be implemented wherever feasible and all lighting will be replaced with an ENERGY STAR approved product.

3. Where applicable, new perimeter lighting on all City buildings will incorporate daylighting techniques. Changes to current lighting will be made, where feasible.

4. Where applicable, maximum use of automatic timers or other electronic means will be used to control usage of electrical current during occupied and unoccupied periods.

5. Lighting levels in buildings, public parking garages, on surface parking lots, and in outdoor areas will be kept as close as feasible to the acceptable minimum standards set by the Illuminating Engineers Society (IES).

B. Office Equipment

1. To the extent possible, and in compliance with procurement regulations, all new office equipment purchased shall be ENERGY STAR compliant. All new equipment purchased by the City of Worcester must be specified to vendor to arrive with ENERGY STAR features enabled.

2. All items of office equipment that have ENERGY STAR features shall have them enabled. These features shall not be disabled by anyone without first receiving joint approval from the Energy Manager and the Mayor.

3. All printers, copiers, fax machines, scanners, and personal computers shall be turned off outside of normal working hours. (The exception to this may be fax machines when fax transmittals are routinely received, or expected to be received, outside normal working hours and the primary server for the network.)

4. Copiers and printers shall be used to make double sided copies whenever feasible.

5. Use of copiers to make mass production (greater than 499) of copies should be restricted between the hours of noon and 3:00 PM, as this is peak power consumption time.

6. All personal computer monitors shall be set for the "sleep" mode after fifteen minutes of non-operation (or the time period in which a screen saver would otherwise be activated). "Sleep" mode reduces power to the monitor without shutting down the PC, and is to be used as an energy saving alternative to screen savers. Monitors that do not have the "sleep" mode can be manually turned off when not in use. An exception will be made in the case of older monitors that do not have the "sleep" mode feature.

7. Screen savers on personal computers shall be disabled so that they do not interfere with the "sleep" mode feature. An exception will be made in the case of older monitors that do not have the "sleep" mode feature.

8. All personal computer monitors that are not ENERGY STAR compliant shall be turned off during periods of inactivity of thirty minutes or more. This does not require that the PC be turned off.

9. Each work area will have an individual assigned the responsibility of ensuring that copiers, printer, fax machines, scanners, computers and room lights are turned off at the end of each workday.

C. Heating and Air Conditioning

1. Windows above a heating or cooling unit should be closed when that heating or cooling unit below it is operating. This applies to all City owned buildings.

2. Where applicable, the City will maximize the use of an Energy Management System (EMS) to reduce energy consumption by scheduling shut down of appropriate HVAC equipment serving spaces during unoccupied periods.

3. Thermostats will be adjusted to maintain the best possible comfort level for all employees. It should not be necessary for employees to operate space heaters during the summer months while air conditioning is operating. Likewise, winter heating temperatures should be maintained at a level that is comfortable for most employees. Every measure will be taken to avoid over-heating or over-cooling a municipal building.

4. Buildings will be maintained in an acceptable range or operative temperature and relative humidity based on ASHRAE Standard 55-1992, or the most recent version of the standard.

D. Water

1. Water saving devices will be installed in all rest rooms and kitchens as upgrades occur.

2. Hot and cold water faucets will be replaced with spring loaded fixtures as upgrades occur.

3. Thermostats will be reduced on hot water heaters to lower temperature from 150 to 110 (not applicable to cafeteria or medical uses).

4. Where feasible, water level of commodes will be adjusted in rest rooms to reduce water usage.

5. Landscaping changes will incorporate consideration of water requirements in order to minimize the need for watering of lawns and planted areas. Xeriscaping practices will be utilized wherever practical or appropriate.

6. Whenever possible, landscaping will incorporate water-efficient, native or adapted, climate tolerant plantings; high efficiency irrigation technologies including micro irrigation, moisture sensors, or weather date-based controllers. Consideration will be given to using captured rainwater, gray water, or on-site treated water to feed irrigation systems.

E. Employee Suggestion Program

1. In recognizing that each employee is knowledgeable about his or her particular job and is in the best position to make valuable suggestions toward our objective of energy efficiency, employee suggestions concerning energy conservation will be welcome and given serious consideration.

Municipal Green Building Policy: Proposed

It is the intent of the City to reduce the life-cycle operating costs and increase the energy efficiency of municipal buildings, by adopting the goal that all construction of new municipal buildings and major renovations and additions to existing municipal buildings will exceed the provisions of Massachusetts State Building Code.

Municipal building projects will seek to meet or exceed the goal of a Silver Certification based on the most current criteria of the Leadership in Energy and Environmental Design (LEED) Green Building Rating System promulgated by the United States Green Building Council, or a comparable scoring system.

Contract agreements for architectural design services for the construction, major renovation, or additions to its municipal buildings shall include the requirement for the design goal of the project with a minimum of LEED Silver Certification, or equivalent level in a comparable building scoring system, unless the DPW & P, Architectural Services Division first makes a finding and reports to the City Manager that such certification is not in keeping with the use or purpose of the building or is otherwise inappropriate.

Contract documents for the public bidding of municipal building projects shall include requirements for the goal of LEED Silver Certification or greater, or equivalent, unless the requirement is not required by the finding and report to the City Manager.

Anti-Idling Policy: Proposed

The City recognizes idling as an unnecessary waste of money and fuel and a senseless contributor to air pollutants and greenhouse gases in the atmosphere. A gasoline vehicle idling for two hours burns two gallons of gas and emits approximately 44 pounds of eCO_2 into the atmosphere. A diesel vehicle idling for two hours burns approximately 1.8 gallons of fuel and emits 38 pounds of eCO_2 into the atmosphere[20]. In addition to emissions, an idling vehicle effect engine life. A diesel vehicle that idles for one hour a day is equivalent in engine wear to driving 64,000 miles and using over 500 gallons of fuel annually. This creates significant maintenance and fuel costs for the City.[21]

The Commonwealth of Massachusetts has mandated a 5-minute maximum idling time for vehicles.[22] The City of Worcester will consider establishing an Idling Enforcement Program for municipal operations, which will enforce the 5-minute idling time prescribed by the State regulations. The primary method of enforcement will be through an educational program as well as through incentives. The City can provide incentives in the form of public recognition for City employees who obey the idling policies of the State and City government.

20 International Council for Local Environmental Initiatives, Green Fleets, from www.greenfleets.org

21 American Trucking Association. 1989. Document #1419 "Diesel Idling," February 2, from www.greentruck.com/air_emissions/1419.html.

22 Massachusetts General Law, Chapter 90, Section 16A, from www.state.ma.us/legis/laws/mgl/90-16A.htm

Fuel Efficient Vehicle Purchasing Policy: Proposed

1. In meeting operational needs, City staff shall consider energy consumption, emissions, and waste generation as part of their decision making process in the management of fleet assets. Saving fuel means saving money. Judicious maintenance and recycling resources add value by extending fleet life and reducing adverse environmental effects.
2. All positions requiring a vehicle shall be evaluated as to the required class size necessary to conduct the job. All new vehicle purchases must be the most fuel-efficient vehicle in the class required for the job provided it is not cost prohibitive or that it will result in the purchase of a vehicle that has been proven to be unacceptable based on other criteria such as performance and ability to serve in the role selected.
3. City staff shall make every possible effort to ensure that the City's fleet assets are selected, acquired, and utilized in a manner that provides for the best possible support of City operations through environmentally responsible Fleet Management. This includes assessing operational needs to minimize fleet size and planning vehicle and equipment use to maximize efficiency and minimize mileage driven.
4. The City will reinforce vehicle and operator awareness to reduce idling time and to adopt conservative driving habits such as gradual acceleration and strict adherence to speed limits.
5. City vehicles shall not be left idling when parked or standing. All areas around school entrances have been designated as Idle Free Zones. No vehicle, City owned or otherwise, may idle in these areas, in accordance with the City's Anti-Idling Policy.
6. City vehicle warm-up periods shall be kept to a minimum.
7. Preventative maintenance shall be performed as scheduled and on time to ensure optimal vehicle operation.
8. Vehicles will be inspected regularly and prior to extended use to ensure correct tire pressure, oil and coolant levels, and to identify possible signs of other fluid leaks.
9. The use of alternative fueled vehicles will be considered whenever cost effective, operationally feasible, and when the use of such vehicles results in reduced energy use and emissions of pollutants and greenhouse gases.
10. The City will purchase ecological products such as coolants and re-refined oils where available and cost effective.
11. The City will dispose of hazardous materials such as waste oil, lubricants, antifreeze, and batteries safely through environmentally responsible practices and in accordance with all applicable state and federal regulations.

Environmentally Preferable Purchasing Policy: Existing

IMPORTANT NOTICE TO BIDDERS

City of Worcester Environmentally Preferable Purchasing Policy

The purchase and use of products and services can have a profound impact on the environment. The City of Worcester recognizes the positive impact that it can make on the environment through the purchasing decisions that it makes. It is the intent of the City of Worcester to integrate environmental considerations into every aspect of acquisition. Although the environment may not be the core of our professional mission, the integration of these factors will result in economic, health, and environmental gains that will further our goals.

Overall Statement of Policy

The City will seek to reduce the environmental damages associated with purchases by increasing acquisition of environmentally preferable products and services to the extent feasible, consistent with price, performance, availability, and safety considerations.

Environmental factors will be taken into account as early as possible in the acquisition-planning and decision-making process.

Responsibility for environmentally preferable purchasing will be shared among the program, acquisition, and procurement personnel.

Definitions

"Recycled Material" means material and by-products which have been recovered or diverted from solid waste for the purpose of recycling. It does not include those materials and by-products generated from, and commonly reused within, an original manufacturing process.

"Post-Consumer Recycled Material" means material and by-products which have served their intended end-use by a consumer and have been recovered or diverted from solid waste. It does not include those materials and by-products generated from, and commonly reused within, an original manufacturing process.

"Environmentally preferable products" means products that have a lesser or reduced effect on human health and the environment when compared with competing products that serve the same purpose.

Policy Statement

Bidders able to supply products containing recycled materials or environmentally preferable products which meet performance requirements are encouraged to offer them in bids and proposals. To this extent, the City reserves the right to award under the following circumstances:

- When the bidder submits an offer to supply an environmentally preferable product or recycled material.
- When the bidder documents the offer of environmentally preferable products or recycled materials.
    - An environmentally preferred product or recycled material may be considered best value even when the price is greater than that of a non-environmentally preferred product or service by an amount not to exceed ten percent.

Appendix B: Resources

The following list of resources is just a few of the many organizations that administer programs and services for individuals, businesses, and institutions both in the city of Worcester and statewide seeking to lower their greenhouse gas emissions. This is not an exhaustive list and the list of resources continues to grow as sustainable development becomes a growing local, regional, national, and international priority. We encourage every reader who wants to learn more about how to lower their impact on earth's resource they can explore these organizations more fully.

The Center for Ecological Technology (CET) is a non-profit (501c3) organization that demonstrates and promotes practical, affordable solutions to the environmental challenges encountered in our daily activities. CET's mission is "to research, develop, demonstrate and promote those technologies which have the least disruptive impact on the natural ecology of the Earth." From offices in Pittsfield, Northampton and Springfield, CET finds sustainable solutions to complex issues in order to benefit our environment, health, economy, and community. Website: www.cetonline.org

Clean Air-Cool Planet (CA-CP) creates partnerships in the Northeast to implement solutions to climate change and build constituencies for effective climate policies and actions. They partner with campuses, communities, and companies throughout the Northeast to help reduce their carbon emissions; help their partners, their constituents, and other regional opinion leaders and stakeholders understand the impacts of global warming and its best available solutions, through comprehensive outreach efforts celebrating commitment, innovation and success in climate action; showcase practical climate solutions that demonstrate the economic opportunities and environmental benefits associated with early actions on climate change; advocate the implementation of effective policy solutions aimed at reducing greenhouse gas emissions at the state and regional levels; and work to build support for the implementation and strengthening of the New England Governors and Eastern Canadian Premiers' regional Climate Change Action Plan. Website: www.cleanair-coolplanet.org

Clean Water Action (CWA) / Clean Water Fund (CWF) is a national 501(c)3 nonprofit environmental organization that brings diverse communities together to work for changes that improve our lives, promoting sensible solutions for people and the environment. CWF is a leader in energy education and mobilization in New England, coordinating the "Northeast Clean Power Campaign" that has won commitments region-wide to reduce pollution from the oldest and most polluting coal- and oil-fired power plants. CWF is also a founding member of the New England Climate Campaign and helped lead the "20% by 2010 Campaign" in both multiple cities in Connecticut and in Worcester, MA, resulting in Worcester becoming the first city in Massachusetts and the largest city in the country to commit to purchase a percentage of its electricity from renewable sources. Website: www.cleanwater.org

Conservation Services Group (CSG) promotes energy efficiency and the development of renewable energy resources to:

1 protect the environment by reducing demand on natural resources and minimizing the harmful local and global impact of nuclear and fossil-fuel (oil, gas, goal) electric power generation

2 make homes and buildings safer, healthier, more comfortable, more durable, and more affordable to operate

3 create a profitable, sustainable industry focused on the wise use of energy thereby contributing to building a more effective and efficient economy overall

They have a lot of experience with solar installations - both residential and commercial - and offer various residential energy efficiency rebates. CSG has its headquarters in Westborough, MA. Website: www.csgrp.com

The ENERGY STAR Program was introduced by the U.S. Environmental Protection Agency (EPA) in 1992 as a voluntary market-based partnership to reduce air pollution through increased energy efficiency. Today, with assistance from the Department of Energy, the ENERGY STAR program offers businesses and consumers energy-efficient solutions to save energy, money, and help protect the environment for future generations. More than 7,000 organizations have become ENERGY STAR partners and are committed to improving the energy efficiency of products, homes and businesses. For more information about ENERGY STAR, visit www.energystar.gov or call toll-free 1-888-STAR-YES (1-888-782-7937).

The Hitchcock Center for the Environment is an independent, nonprofit, environmental education center located in Amherst and serving the Pioneer Valley for over 43 years. The Hitchcock Center's mission is to foster greater awareness and understanding of our environment and to develop environmentally literate citizens. Serving over 6,000 individuals each year, the Hitchcock Center provides award-winning environmental education programs in the areas of professional development and curriculum programs for teachers, field trips and classroom presentations for area schools, preschool and summer camps for children, youth and families, and natural history programs for adults and the community at-large. The Hitchcock Center designs its programs to: 1) provide students of all ages with opportunities to construct their own understandings of the environment through hands-on, minds-on investigations; 2) involve youth and adults in direct experiences that challenge them to use higher-order thinking skills; 3) develop an active learning community where participants share ideas and expertise, and prompt continued inquiry; and 4) provide real-world contexts and issues from which concepts and skills can be used. Through various educational programs, we foster the awareness and appreciation that motivates us to serve effectively as environmental stewards. Visit the website at www.hitchcockcenter.org or call (413) 256-6006 for more information.

ICLEI - Local Governments for Sustainability is an international association of local governments and national and regional local government organizations that have made a commitment to sustainable development. More than 475 cities, towns, counties, and their associations worldwide comprise ICLEI's growing member-

ship. ICLEI works with these and hundreds of other local governments through international performance-based, results-oriented campaigns and programs. The Cities for Climate Protection™ (CCP) Campaign enlists cities to adopt policies and implement measures to achieve quantifiable reductions in local greenhouse gas emissions, improve air quality, and enhance urban livability and sustainability. Website: www.iclei.org

The Massachusetts Climate Action Network (MCAN) is dedicated to halting the threat of global climate change. They strive to reduce emissions of greenhouse gases, principally carbon dioxide, in our communities and the state. The MCAN Network is composed of local and statewide groups that have joined together in a cooperative effort. There are 14 local groups and four regional or statewide environmental groups in MCAN at present. The Town of Amherst joined MCAN in 2005. The group's efforts are principally devoted to conducting public education and influencing municipal governments in their home communities, to achieve local reductions in greenhouse gas emissions. MCAN is also striving to change climate policy at the state level in Massachusetts, through influencing the state's climate action plan; legislation related to energy efficiency, renewable energy, and transportation; and regional planning efforts. Website: www.massclimateaction.org

Massachusetts Energy Consumers Alliance is a non-profit organization that both advocates and acts in the marketplace on behalf of consumers and the environment. They have offered discount heating oil since 1982 and now serve 10,000 households. They also offer green electricity options and solar energy services. Their advocacy work serves all consumers and our charitable programs benefit low-income households and other nonprofit organizations. Website: www.massenergy.com

Massachusetts Interfaith Power & Light (MIP&L) is a non-profit initiative to offer Massachusetts congregations of every religious tradition a comprehensive means of reducing energy consumption, lowering operating costs, and promoting clean, renewable energy in houses of worship and related buildings. In short, we are a mutual ministry to work with the community of faith toward environmental justice and care of creation. Website: www.mipandl.org

Massachusetts Technology Collaborative (MTC) is the state's development agency for renewable energy and the innovation economy, which is responsible for one-quarter of all jobs in the state. MTC administers the John Adams Innovation Institute and the Renewable Energy Trust. They work to stimulate economic activity in communities throughout the Commonwealth. As their name suggests, MTC uses a collaborative approach to achieving the organization's mission. MTC brings together leaders from industry, academia, and government to advance technology-based solutions that lead to economic growth and a cleaner environment in Massachusetts. By developing energy from wind, solar, and other renewable resources, MTC is reducing reliance on coal, oil, and other fossil fuels that contribute to air pollution and global warming. Investments in the emerging clean energy market stimulate new economic activity in the renewable industry and job growth across Massachusetts. Technol-

ogy-driven innovation fuels our economy. MTC is uniquely positioned to provide economic development solutions working with the Governor and State Legislature. By forming dynamic partnerships with key stakeholders, the agency serves as a catalyst for growing the innovation economy. Website: www.masstech.org

National Biodiesel Board (NBB) is the national trade association representing the biodiesel industry as the coordinating body for research and development in the US. It was founded in 1992 by state soybean commodity groups, who were funding biodiesel research and development programs. Since that time, the NBB has developed into a comprehensive industry association, which coordinates and interacts with a broad range of cooperators including industry, government, and academia. NBB's membership is comprised of state, national, and international feedstock and feedstock processor organizations, biodiesel suppliers, fuel marketers and distributors, and technology providers. The mission of the National Biodiesel Board is to advance the interests of its members by creating sustainable biodiesel industry growth. NBB serves as the industry's central coordinating entity and will be the single voice for its diverse membership base. Website: www.biodiesel.org

National Grid (NGRID) Massachusetts Electric serves a total of 1.2 million customers in 168 Massachusetts communities including Worcester and is an electricity distribution subsidiary of National Grid. They provide a host of resources and financial assistance for energy efficiency, demand response, and energy management. A more detailed listing of some of their programs are described in Appendices F and G. Website: www.nationalgridus.com/masselectric/index.asp

The Northeast Sustainable Energy Association (NESEA) is the nation's leading regional membership organization focused on promoting the understanding, development, and adoption of energy conservation and non-polluting, renewable energy technologies. For more than thirty years, NESEA has facilitated and enhanced a network of professionals, practitioners, and other citizens in pursuit of responsible energy use. NESEA's programs and activities focus on the northeastern United States, from Washington, DC to Maine. NESEA is a chapter of the American Solar Energy Society. NESEA recognizes and responds to the crucial connections between the generation and use of energy and the whole systems that sustain planetary health. NESEA envisions energy systems that interact to preserve and improve our air, water, resources and ecosystems, while vitalizing economies, building local security and regional self reliance, and improving the quality of all life. NESEA acts as a hub that connects people across a broad base of interests and disciplines. Its network of active citizens, professionals, businesses, and organizations in the Northeast seeks to discover and demonstrate the responsible production and use of energy. NESEA collaborates and cooperates with allied organizations to advance common interests. It celebrates, inspires, and nurtures visionary ideas, emerging markets, and practical solutions. Website: www.nesea.org

NSTAR is the largest Massachusetts-based, investor-owned electric and gas utility. They transmit and deliver electricity and gas to 1.1 million electric customers in 81 communities and 245,000 gas customers in 51 com-

munities. NSTAR is Worcester's natural gas provider. From a corner market to a billion-dollar industrial campus, their menu of recently enhanced energy-efficiency programs offers customers the opportunity to reduce energy consumption and save money, while maintaining or improving working conditions. For more details on these programs see Appendix F. Website: www.nstaronline.com

The Regional Environmental Council (REC) is the leading grassroots environmental organization in Greater Worcester, with a rich history of community education around sustainability and open space issues as well as reducing toxic threats to our health. REC is a 501(c)3 organization with a strong community-based board and membership and deep-rooted connections to local businesses, energy leaders, decision-makers and the general population of Worcester. At the heart of REC's success is its ability to partner with many organizations including neighborhood groups, advocacy groups, government officials, businesses, and schools. REC organizes Worcester's official Earth Day clean-ups and celebration annually and leads highly successful youth organic farming and community gardens programs. Website: www.recworcester.org

Appendix C: Timeline of Worcester's CCP Involvement

October 7, 2003: By a unanimous vote of the City Council, Worcester joins over 140 US communities in the Cities for Climate Protection Campaign (CCP). This is a world-wide campaign of the International Council on Local Environmental Initiatives (ICLEI). Participants commit to address regional and global environmental challenges at the local level. Specifically, the CCP campaign offers 5 milestones for achieving global warming pollution reductions: (1) Perform a baseline emissions inventory of the sources and quantity of greenhouse gases (GHGs), along with a forecast of emissions growth; (2) Set an emission reduction target; (3) Write a Local Action Plan outlining the activities that will be pursued to achieve the emission reduction target over a period of years; (4) Implement these emission reduction policies; (5) Monitor the progress of measures to reduce greenhouse gases.

December 3, 2003: Mayor Murray speaks at Clark University's Sustainable Solutions to Climate Change Conference on behalf of the City of Worcester and discusses the commitment to reducing greenhouse gas emissions.

April 1, 2004: Milestone one, performing a baseline emissions inventory of GHGs, is completed by Carissa Williams as part of her MA thesis for Clark University. ICLEI awards Mayor Murray a plaque listing the five milestones, the first of which has a gold star inserted next to it, representing its completion.

March 29, 2005: City Council unanimously passes a Clean Energy Resolution proposed by Carissa Williams, who is acting as a consultant to Clean Water Action – Boston and The Regional Environmental Council. More than 40 residents of Worcester come out to the city council vote to show their support for the Clean Energy Resolution. This resolution states that the City of Worcester will purchase 20% of the electricity used for municipal operations from clean, renewable sources of power by 2010.

March 31, 2005: A press conference is held in Mayor Murray's office to announce the city's commitment to clean energy and to issue a challenge to residents, businesses and institutions in Worcester. Attendance includes Senator Edward Augustus, Mayor Timothy Murray, City Councilor Barbara Haller, and City Councilor Mike Perotto. The event was covered repeatedly on WTAG radio and on WCTR Worcester News Tonight.

May 3, 2005: City officials and employees meet with environmental advocates, Mass Energy, and MTC to discuss clean energy purchasing options and funding opportunities. In attendance is Mayor Murray, John Orrell, John O'Day, Bob Fiore, Martha Broad (MTC), Larry Chretien (Mass Energy, President), Peggy Middaugh (REC), Lara Hoke (MIP&L), and Carissa Williams.

June 2005: Mayor Murray signs on to the U.S. Mayors Climate Protection Agreement, joining 159 US mayors

in support of reducing local greenhouse gas (GHG) emissions to reach Kyoto targets, urging the state to meet Kyoto targets, and urging the U.S. Congress to pass the original bi-partisan Climate Stewardship Act.

July 20, 2005: Mayor Murray tours the wind turbine at the IBEW Local 103 in Dorchester with environmental advocates and Mass Energy. The purpose of this visit is to see firsthand the potential for renewable technologies in a large city.

July 2005: MTC notifies the City of Worcester of 1st quarter Clean Energy Choice earnings totaling $11,837, which is available for use on clean energy projects.

September 13, 2005: City Manager Mike O'Brien requests and receives authorization from City Council to request from MTC that Worcester use the CEC money to hire a part-time Energy Coordinator who will conduct assessments of current clean energy projects, determine future clean energy programs, and expand the City's clean energy efforts through partnerships and collaborative initiatives. Through these studies, the Energy Coordinator will evaluate the City's potential cost savings relating to alternative energy choices.

September 30, 2005: Mayor Murray speaks at ICLEI's Conference, Creative Funding for Clean Energy Projects, about "making the commitment to Clean Energy".

February 2006: City Manager Michael V. O'Brien appoints thirteen members to Worcester's Energy Task Force. City Council approves the use of Worcester's Clean Energy Choice Funds from the Massachusetts Technology Collaborative for hiring an Energy Coordinator in conjunction with the Regional Environmental Council.

September 2006: Energy Task Force web pages go up on the City's website. http://ci.worcester.ma.us/ocm/energy/home.htm

Appendix D: Energy Task Force Meeting Minutes

March 22, 2006 - ETF Meeting One

Hello members of Worcester's Energy Task Force,

Thank you for attending our first meeting March 22, 2006. Our next meeting will be April 26th 2:30-4pm. Sub-committees will meet before then.

In attendance:
Stephen Willand, Chair
Carissa Williams, Coordinator
John Orrell, City Purchasing
Bob Fiore, DPW
Larry Chretien, Mass Energy
Casey Steele, Mass Energy
John Carney, WRTA
Brian Blood, NSTAR
Joseph Zwirblia, Airport Commission
Rob Krueger, WPI
Peggy Middaugh, REC
Peter Russo, National Grid

Missing:
John Rugg, Municipal Vehicle Fleet
Adam Parker, CSG
Eric Twickler, City Architect
Aleta Fazzone, National Grid
Gene Olearczyk, WPS

Attached is an excel file titled "members.xls" that contains contact info for Energy Task Force Members and allies.

Meeting Minutes: Wednesday, March 22 from 2:30pm to 4:00pm 44 Front Street, Worcester, Suite 300

Handouts: The Resolution to form an Energy Task Force submitted by the City Manager to the City Council, The Scope of Services for my position as Energy Consultant (see attached), A one-page summary of Mass Energy's programs, an insert that appeared in the T&G Feb. 24 about businesses and energy.

I. Introductions / Welcome (2:30-2:40)

a. Attendance / Contact Info

We collected/updated everyone's contact info. See attached excel file.

b. Welcome by Stephen Willand

Ted Jankowski, Assistant City Manager, came to welcome and thank the Energy Task Force members saying this task force comes at an opportune time and stressing the importance of energy awareness and the availability of Clean Energy Choice Funds.

c. Introductions

II. Presentation: Background of the Energy Task Force (2:40-3:30)

a. Presentation with Questions / Discussion

See attached for .ppt presentation. Presentation was followed by a great discussion about ideas for Worcester Climate Action Plan, including the importance of public outreach and educations, as well as communication / publicity. We are interested in creating a marketing campaign around Worcester and environmental awareness, including a website as part of the city's site. Communications efforts will be spear-headed by Stephen Willand. Public outreach ideas discussed include getting info out through schools and creating a residential version of the Business Energy Review published in the T&G recently. A summary energy profile of Worcester was requested (see attached "EnergyProfile, CityofWorc.doc").

b. Look over Local Action Plans from other MA CPP cities

If you took a plan, please make sure if gets back to me at some point. I can also email copies of any of the plans upon request.

c. Determine the structure and working operations of the task force

We decided to meet as a whole group next month and bi-monthly after that. Our next Energy Task Force meeting is Wed, April 26th 2:30pm-4pm at 44 Front Street, Worcester, Suite 300. See below for info on sub-committee meetings.

III. Sub-Committees (3:30-3:45)

a. Choose sub-committees

There are three major subcommittees of which every member is on at least one. I, Carissa Williams, am coordinator of all sub-committees. Sub-committees and their members are as follows:

Energy Efficiency: Bob Fiore, Eric Twickler, Rob Krueger, Aleta Fazzone, Peter Russo, and Brian Blood

Renewable Energy: John Orrell, Eric Twickler, Adam Parker, Joseph Zwirblia, and Larry Chretien / Casey Steele. This group will be sure to include a focus on meeting the City's resolution to purchase 20% elec tricity from renewable sources by 2010.

Transportation: John Rugg, Peggy Middaugh, John Carney. Sub-committees may invite other non-energy task force members to be a part of their sub-committees. Other areas that the Energy Task Force will

focus on include: Public Outreach and Education, Communications/Publicity, Funding Opportunities, Solid Waste and Recycling, and Green Spaces

b. Discuss sub-committee meeting schedules and deliverables

Sub-committees will meet as needed between Energy Task Force meetings, they may also communicate through email and phone in addition to (or, in some cases, in lieu of) in person meetings. Sub-committees will be responsible for bringing a summary handout of the ideas/discussions/conclusions they have had.

IV. Healthy Communities Grant Program (3:45-3:50)

a. Discuss Application / Uses – One page summary due 4/5/06

We are going to apply for this grant for use on public education. I will work with Donna McGrath, City Grant Writer, to write the grant and submit it. I will send a draft out to Energy Task Force members be forehand for comments.

V. Wrap Up (3:50-4:00)

a. Set Energy Task Force meeting schedule

We decided to meet as a whole group next month and bi-monthly after that. Our next Energy Task Force meeting is Wed, April 26th 2:30pm-4pm

b. Determine next steps

Sub-committees meet at least once before our next meeting.

The group decided to send me to ICLEI's North American Congress July 11-14 in Chicago, IL. Here US, Canadian, and Mexican participants in CCP and other ICLEI programs will gather and discuss progress, obstacles, and new ideas. ICLEI pays for airfare for the elected liason (Mayor Tim Murray) and a staff person. They negotiate gov't rates for registration and hotel.

Thanks again to everyone. Our first meeting was a great introduction to each other, the Cities for Climate Protection Campaign and the City of Worcester's involvement in CCP thus far. I look forward to working with all of you and being a part of a productive task force.

Enjoy the weekend!

_____

Carissa Williams

Energy Consultant, City Of Worcester

April 12, 2006 - Transportation Sub-Committee Meeting One

Hi All,

Sorry this is a week delayed. I have been out of work. First of all, thank you for attending the Transportation Sub-committee meeting last week. To recap, in attendance was: Peggy Middaugh of the REC, John Carney of the WRTA, Tom Moore – interested citizen and member of Worcester fire dept., Karen Goins – interested citizen and public health employee, Dave Schmidt – Clark University student writing a report on biodiesel.

Overall, we had a good discussion on a variety of ways to reduce air pollution from transportation, including biodiesel, hybrid vehicles, public transportation, car-sharing/pooling and telecommuting, anti-idling, purchasing policies, and a bikeable/walkable city.

In the end, we decided to look further into:

- Biodiesel – getting case studies from other municipalities, getting emissions statistics, looking at Dave's report
- Hybrids – getting info on the city's current hybrids, the technology, municipal case studies
- Encouraging employees and residents to:
    - carpool/car-share (zipcar-like),
    - use public transport,
    - use smaller cars/more efficient cars,
    - telecommute,
    - bike or walk as a means of transport
- Anti-Idling - creating signs at schools as a part of our larger public education clean energy campaign; potential enforcement
- Traffic light synchronization
- Emission-friendly bus stops (after lights)
- Purchasing Policies – purchase most fuel efficient vehicle for the job; require more strict emission standards when contracting with school buses, construction companies, public buses, etc.

John Carney's Tasks:

- Brainstorm ideas to get more people to use the WRTA as a means of transport, particularly with students of the consortium – send to me.

John Rugg's Tasks:

- Send info on city's hybrids (John I will send you a more detailed email on this)
- Send info on Worcester Vehicle fleet – vehicle year, make, model, purchase date, what it's used for, mileage, use history (aka how often it's used, is it seasonal, weekly, daily, and how much - miles/year), maintenance schedule (if applicable), type of fuel used, fuel efficiency

Peggy's Tasks:

- Find out if colleges/businesses/municipality would use zipcar or a zipcar like program; if these places were not to use such a program, find out how they feel about at least guaranteeing a ride home in an emergency. Send me info.
- Also find out (if applicable) how these places feel about telecommuting, subsidizing public transport, offering showers/changing rooms, offering bike racks, offering preferred parking to fuel efficient cars.

Carissa's Tasks:

- Research and get case studies on hybrids and biodiesel in municipalities
- Look into traffic light synchronization – what's been done, what is being done now with CMRPC, and what should be done - John R., Do you have this information?
- Send you all anti-idling law (attached)
- Send non-committee members background info
- Draft or get Samples of Purchasing Policies

Tom's Tasks:

- Brainstorm ideas on educating residents about biking, walking, public transport, idling, hybrids/fuel efficient vehicles – send to me

Dave's Tasks:

- Continue work on biodiesel research and report. Send to me when complete.

Karen's Tasks:

- Brainstorm ways of making city bikeable/walkable that can be implemented by the municipality – send to me.

Thanks again! It would be great to have this info by this coming Wednesday if possible – that is when the Energy Task Force Meeting is (not subcommittee), but I understand that is very soon. Let's definitely get this info by next Wednesday though, May 3rd.

Our NEXT MEETING, MAY 10th at 12noon.

Carissa Williams
Energy Consultant, City Of Worcester

April 12, 2006 - Energy Efficiency Sub-Committee Meeting One

Hi All,

Sorry this is a week delayed. I have been out of work. First of all, thank you for attending the Energy Efficiency sub-

committee meeting almost two weeks ago. To recap, in attendance was: Peter Russo of National Grid, Jeff Lassey of Worcester Public Schools, Rob Kruger of WPI, and myself.

Overall, we had lots of good discussion around National Grid energy efficiency rebate programs, municipal energy efficiency policies, energy efficiency in schools, and South High's heating system.

In the end, we decided to look further into:

- Municipal buildings lighting upgrades with funding from National Grid
- In particular, changing the metal-halide lights in the Ameresco city parking garage to flourescent lighting. Garage lights are on 24-7, 8,760 hours/year so this will result in both cost and energy savings. - UMASS recently did this to their parking garage.
- School equipment upgrades – any electric systems – with funding from National Grid
- Monitoring energy use in high use buildings – National Grid monitoring system (EPO-metering)
- Energy Efficiency upgrades at water filtration plant and sewage treatment plant – need to find out how much control Worcester has over these buildings which are just outside of the city (Holden and Millbury)
- Creating an energy efficiency policy including, purchasing energy star office equipment, proper use of office equipment/ lighting/ heating and cooling, and more strict efficiency standards for new municipal buildings – holding dept. heads accountable for overseeing applicable portions of this policy.
- Using the new vocational high school as a case study for educating the public and other municipalities about energy efficient "green" building

We also discussed:

- South high going to gas heating soon – current electricity for South High and Sullivan is $400,000/yr
- National Grid's Small Commercial and Industrial rebate program – city pays 20% of upgrade cost / 16% if paid in cash (any buildings with a peak demand under 100KW)
- 12 schools have been audited for changing lighting
- Installing a new chiller for Ice Rink and City Hall – National Grid giving rebate
- DCU center's efficiency upgrades
- Wood gasification used in Wachusett
- Streetlighting – already efficient, off-peak load, on lighting senser, rate is cheap
- MassSave – National Grid's residential efficiency program
- Energy Storage – lose some energy by storing

Peter's Tasks:

- Send me spreadsheet with data on efficiency upgrades in Worcester over the past 5 years, including current projects, as well as any project suggestions/offers that the city has yet to take advantage of

- Send me cost/ngrid funding, timeline, and efficiency info on upgrading Ameresco garage

Jeff's Tasks:

- Send me spreadsheet with data on efficiency upgrades in the Worcester Public School over the past 5 years as well as planned upgrades

Rob's Tasks:

- Send me info on what WPI has done to help reduce emissions over the past five years – this info can also be included in our Climate Action Plan

Brian's Tasks:

- Send me any info on NSTAR's efficiency programs

Bob's Tasks:

- Do you know how much control Worcester has over the water filtration and sewage treatment plant and who has this control (DPW?)? Even if they are privately owned, I bet we could still work with them to find out what equipment is out-dated and where efficiency improvements can be made, and then help to implement these.

Carissa's Tasks:

- Draft energy efficiency policy
- Work on creating a case study of the voc school

It would be great to have this info for our meeting on Wednesday, particularly about what efficiency projects Worcester can implement, since we are supposed to have a handout to present to the Task Force. I understand if it takes a little more time to get everything though. Thanks again! See you on Wednesday for the full Energy Task Force meeting.

Carissa Williams
Energy Consultant, City Of Worcester

April 12, 2006 - Renewable Energy Sub-Committee Meeting One

Hi All,

Sorry this is a week delayed. I have been out of work. First of all, thank you for attending the Renewable Energy Sub-committee meeting last week. To recap, in attendance was: Casey Steele and Larry Chretien of Mass Energy, Adam Parker of CSG (Conservation Services Group), Eric Twickler – City's Principal Architect, John Orrell – City Purchasing, Joe Zwirblia of the Regional Airport Commission.

Overall, we had lots of good discussion around wind turbine siting and solar panels.

In the end, we decided to look further into:

- Putting a wind turbine on the Ecotarium's Crow Hill and having the new North High use the electricity and waste heat with an educational display at the Ecotarium
- Putting ground mounted solar panels by the water filtration plant

We also discussed:

- Green Hill Park as a potential wind turbine site – Eric suggested this would be a hard place to site due to the opposition for the Voc school; however, this opposition may not be opposed to a wind turbine
- Solar Panels on Municipal Buildings – which building would be best (schools, city hall – something that would make good media). Installation issues with roofs were discussed and our conclusion was that ground mounting may have less complications
- Solar Panels on water towers; for outdoor lighting at the airport
- Getting written case studies on solar panels in municipalities
- Potential Energy from food waste – food processing plants in Worcester
- Residential wind turbine permitting – no special permit needed, only need to meet noise standards and may need to get permit for running electricity (very easy to get)
- MTC's renewable funding opportunities – having a rep from MTC come to one of our meetings
- North High is on track to be qualified for LEED-Silver certification (energy, water, waste efficient, etc), however, they may not apply for it because of the paperwork and costs associated with getting the certification paper

Larry's Tasks:

- Send me case studies of solar panels being installed by a municipality

Eric's Tasks:

- Send me all of the background info and updates on the North High Wind project (who has been involved in the conversation, what the current status is, what info is needed to move forward, who do we need to involve to move forward)

Adam's Tasks:

- Create and send me info sheet on potential scenarios of installing solar panels – both ground mounted and roof-mounted (costs, timelines, kWh generated, who we would work with and in what capacity)

Joe's Tasks:

- If possible, it would be nice if you could send me an energy profile for the airport – electricity, heating oil, natural gas, vehicle fuel, anything else you think – whatever information you can get.

Carissa's Tasks:

- Find out if there is a food processing plant or any place with a large amount of food waste in Worcester – Adam, what about the colleges? How much food waste would we need to have?
- Create an excel formatted info sheet on MTC funding opportunities
- Look into streamlining process and costs of LEED certification

It would be great to have this info for our meeting on Wednesday since we are supposed to have a handout to present to the Task Force. I understand if it takes a little more time to get everything though. Thanks again! See you on Wednesday for the full Energy Task Force meeting.

_____

Carissa Williams
Energy Consultant, City Of Worcester

April 26, 2006 - ETF Meeting Two

Hello Energy Task Force Members,
Here are the minutes for the second Energy Task Force Meeting, April 26, 2006. In attendance, Kim Lundgren (NE Regional Coordinator, ICLEI) Stephen Willand, Carissa Williams, Peggy Middaugh, John Carney, Peter Russo, Rob Krueger, Larry Chretien, Adam Parker, Jeff Lassey, Joe Zwirblia, and Eric Twickler. As requested I've attached the updated excel sheet with everyone's contact information "Members.xls".

FYI: Attachments are coming in a separate email.

Next Meeting: Wednesday, June 7th 2:30-4pm @ 44 Front Street, 3rd Floor

MISSION and GOALS

The bulk of our meeting was spent hashing out our mission and goals. We are working off of three City Council Resolutions, attached "CACPSresolution.pdf" "CleanEnergy Resolution.pdf" and "WorcesterEnergy.pdf" Here is what we agreed upon:

Mission: Create a step-by-step plan to reduce energy consumption, reduce greenhouse gas emissions and increase the use of clean, renewable energy in a cost effective manner in the city of Worcester.

Goals:

- Decrease greenhouse gas emissions __% below 2002 levels by _____ (we have yet to set our target)
- Make significant progress towards increasing the use of renewable electricity in municipal operations to 20% by 2010

- Save money on energy costs
- Gain public acceptance for Worcester's Climate Action Plan
- Educate residents of Worcester on how to reduce greenhouse gas emissions and other air pollution
- Act as a leader for other local governments

We also discussed the goals of the three sub-committees. We have defined broad goals for the sub-committees, which the individual sub-committees will narrow in on as needed and we will discuss at a later time.

ICLEI and CCP

Kim Lundgren, the Northeast Regional Director of CCP, attended our meeting and shared with us some additional details about ICLEI, Local Governments for Sustainability and about the CCP Campaign. Attached is the electronic form of one of the booklets she gave out on sustainable transportation options "Sust_Trans_Options.pdf". Kim also discussed the benefits of becoming a member of ICLEI. Though Worcester is a participant in the CCP Canpaign, we are not yet a member of ICLEI. To become a member, we must pay annual membership dues. See the webpage below for the benefits of ICLEI membership-one big thing is exclusive eligibility for grants. Attached are "CCP_FAQs.pdf" which explains the program succinctly and "CCP_US_cities.pdf" which is a list of other CCP cities in the US (from Nov 2004).

ICLEI's webpage <http://www.iclei.org>

ICLEI's CCP webpage <http://www.iclei.org/index.php?id=800>

ICLEI's NorthEast Region Webpage <http://www.iclei.org/index.php?id=1854>

Benefits of ICLEI Membership <http://www.iclei.org/index.php?id=424>

Cost $1750 per year

Clean Energy Choice

We had a discussion about how the Clean Energy Choice Program works and what it is. As requested, here is a summary and attached is a chart that may help in explaining, "CleanEnergyChoice.pdf"

Clean Energy Choice is a program of the Mass Technology Collaborative (quasi-state organization). They are responsible for administrating the Renewable Energy Trust Fund, which is funded through a small charge on every ratepayers electric bill. They are responsible for using this money to increase the demand for renewable electricity in MA.

- National Grid electric customers have the option to purchase renewable electricity by paying extra on their electric bill (amount depends on kwh used and on option chosen, but is typically $4-$12 additional /month).
- The Massachusetts Technology Collaborative matches and doubles consumers' additional payments.
- For every $1 a consumer pays for clean energy, up to $1 is given to the consumer's city and up to $1 will be given to low-income areas in Massachusetts (city must apply for this low-income funding).
- This money from Massachusetts Technology Collaborative must be used for clean energy projects.

- Billing and service remain with National Grid. Cancel or enroll at any time – no fees.

Education and Marketing Campaign

- We discussed our logo, tagline (Worcester, the GREEN heart of the Commonwealth), and campaign name "CLEAN AND GREEN".
- We have been invited to submit a full proposal to the NE EPA for a public education grant - the goal of which is to encourage residents and businesses in Worcester to reduce energy use, reduce greenhouse gas emissions, and increase support for renewable energy.
- I will be sending around a draft within the next few weeks.
- We have also gotten the web space on the City website – now we just need to get stuff up! I will send around a notice when this happens.

Other Funding

July will probably the next round of funding for the MA DEP grants to CCP communities.

Reduction Measures

We really were out of time and didn't get into this as much as I planned. However, there was a lot of spirited discussion around these action items.

- Solar Panels at Water Filtration Plant: According to Eric Twickler, this is a go if numbers work. I am working up the numbers.
- Wind Turbine: North High (Crow Hill) or Green Hill, one consulting company met with assistant city manager and gave him two wind maps from MTC – see attached "WindResources_Worcester.pdf" and "WindandCitySpace_WORCESTER.pdf". These are also online at <http://www.masstech.org>. MTC is attending the next renewable energy sub-committee meeting May 17th @ to discuss our funding options. Everyone is welcome to attend.
- Sensor Controls on lighting in Parking garages: We need to find out if Worcester's garages have these and if not, why not and what would be involved to have these.
- Diesel Emissions: According to John Carney, in Jan 2007 all diesel vehicles will have to be equipped with a "trap" to reduce emissions. Question: What type of emissions will be reduced?
- Solar Panels at City Hall: This keeps coming up because of it's location and the fact that it's City Hall. This may be a possibility (at very little cost to the City) just to do a small demo project, depending on MTC new incentives which are in the process of being determined.
- Express bus service: From train station to select locations around the center of Worcester. See example in ICLEI Sust. Tranportation .pdf.
- Water Meter Reading Vehicles: According to Kim Lundgren, hybrids are not necessary for this job – Medford uses electric golf carts 9 months out of the year for this. She also suggested GM-Gems small electric (?) vehicles

<40 miles/hr – they don't make anymore but may be able to get.

It was suggested we create a chart of our emission reduction ideas showing the cost per unit of greenhouse gas emissions so that we can see where our money will be best spent.

I know there were a lot of other things that were said and suggested. I just couldn't get them all down as our meeting was somewhat chaotic at times. If I am missing things that you said or that you remember hearing, please send them along!

Thanks!

See you all soon at our sub-committee meetings,
Carissa

Carissa Williams
Energy Consultant, City Of Worcester

May 10, 2006 - Transportation Sub-Committee Meeting Two

Hello Transportation Sub-Committee,

Sorry this has taken me so long to get out, but here are the minutes from our meeting in May. In attendance: Peggy Middaugh, Karin Goins, John Rugg, John Carney, Carissa Williams. Our next meeting is Monday, June 19th from 10-11am at 44 Front Street.

We discussed the municipal reduction measures that we will focus on and the municipal transportation data collection.

- John Rugg brought up that most med-heavy duty vehicles not over 12 years old are equipped with automatic shut-off that can be set for anywhere from 1-60 minutes. 5 minutes idling is the law in MA. This is currently not enabled in vehicles, but John R. is working on get this done. There will need to be some employee education – it will take a bit to change behavioral habits. - John R.
- Biodiesel (B5) pilot program at reservoir fueling station – 685 vehicles fuel there (John R. is this correct?) - Carissa
- Using students to do research on idling and anti idling education.
- Drafting a green fleet policy and an anti-idling policy for the City Council - Carissa
- Karin and I met with CMRPC to discuss transportation planning in the community. We are also setting up a meeting with the planning department. - Karin and Carissa
- Departments involved in vehicle fleet maintenance: DPW (includes 34 schools vehicles), Cemetery, Reservoir (filtration), Airport, Police, Fire, Green Hill - Parks (? John R. is this still a separate vehicle fleet?)

- Employee Incentives: We really need to look further into these for implementation. How can the city and other businesses encourage/offer telecommuting, carpool/car share, preferred parking for efficient vehicles, public transportation incentives, biker/pedestrian friendly incentives? Who do we need to talk to in the City about these things? Maybe it is the transportation committee. Peggy, are you still working on this? Any information/results to show? - Peggy
- Public Transportation: WRTA Buses. Work with city. Work w/ students. Offer a monthly student bus pass. Use students to do surveys/research about where students want to go, bus use patterns, factors contributing to/against using the bus, etc. Working with school vans and shuttles. The RTA is developing new marketing materials and John C. has sent me some sample posters. - John C.

Thanks!

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Carissa Williams
Energy Consultant, City Of Worcester

May 17, 2006 - Renewable Energy Sub-Committee Meeting Two

Hello Energy Task Force,
I am sending out the Renewable Energy sub-committee meeting minutes to the entire task force because many of you were there or have expressed interest in what was discussed. In attendance was a representative of Bob Hoyt, Water Filtration Plant in Holden (sorry I can not remember his name); Phil Guerin, DPW Director of Environmental Systems; Joe Zwirblia, Regional Airport Commission; Eric Twickler, City Architect; Larry Chretien and Cassie, Mass Energy; Peggy Middaugh, REC; Carissa Williams, Energy Consultant; Tyler Leeds, MTC; Jim Christo, MTC.

Our next renewable energy sub-committee meeting will be Wed. June 21st from 10-11:30am. We will be discussing Renewable Energy Certificates (RECs) and how to apply for MTC funding.

We had two representatives, Jim Christo and Tyler Leeds, of the Mass Technology Collaborative come to present the funding opportunities for wind, solar, and hydro electricity. There are three programs available: Large Renewables, Small Renewable, and Municipal Wind (see attached info sheets).

Our conclusions:

- Put a small amount (under 10 kilowatts) of solar electric panels at the water filtration plant in Holden. Apply for the Small Renewables grant from MTC to fund part of this. Secure city's commitment and then find a company/organization to take care of solar installation, monitoring and grant writing. MTC has said they can fund this even though the plant is in Holden.
- In the fall, look into doing a small solar system at the voc school as a joint program with WPI – contact Ted

Coghlin in September.

- Decide where to put large wind turbine. Measure wind where data is unclear or there is high risk (aka project is large and expensive). May need to apply for a wind feasibility grant from the MTC Large Renewables program (LORI). Possible locations: Greenwood St Landfill; Ecotarium (Crow Hill).
- Once an appropriate location is found, apply to LORI for wind turbine construction grant. Again, secure City's commitment and solicit for installation, monitoring and grant writing.
- Look into hydro power at the water filtration plant. There is a 50-60 ft head where 23,000,000 gallons/day run between the reservoir and plant. MTC has said they could fund this w/ LORI. Next steps would be to get a commitment from the city and find a company to install, monitor and write the grant. Another option is to install this hydro power at the wastewater treatment plant in Millbury (Worcester supplies 90% of sewage) which dumps 36 million gallon/day into the Blackstone River. The facility is currently undergoing $160 million capital improvements and the hydro power could be worked into those.

It seemed that LORI was a better option for Worcester than the Municipal Wind program because the City would have more control over what got done and could work on a faster timeline.

Other Options:

- Solar at DCU Center
- Solar and/ or wind at the airport

Discussed Ideas:

- Hydro at Coes Pond Dam – 150ft drop – this is not a good option because MTC would not fund and the water is not always flowing.
- Solar on Parking garages – no place to put solar panels

Important Info/Discussion:

- Water Plant Energy Profile. I have hard copies of the details of the water filtration plant's electricity profile if anyone would like a copy I can mail to you or you can pick up. In summary, the plant spends ~$270,000/yr on electricity at ~$.08/kWh from Holden's Municipal Electric Utility. From this info it would seem that the plant consumes 3,375,000 kWh/yr but I am unsure if this is correct and I am having difficulty deciphering the electricity data from the plant. Bob H., can you clarify this? It seems the data I have doesn't include kWh, just KW but maybe I am misreading. In the winter, water use is less and so electricity consumption is less. About 1/3 of the electricity consumed is used to make ozone for filtration. Holden performed an energy audit on the plant recently and many efficiency measures have been implemented (such as LEDs and fluorescent lighting, light sensors, etc.). This has reduced the demand charge from $6-$7,000 to $4-$5,000.
- Support for Wind. According to Jim Christ from MTC, it is important to involve the community when moving

forward with a wind project. Often opposition is due to misinformation or lack of information. View shed can be a big issue with big turbines.

- Wind Turbine Data. Here is just one example of the cost and electricity output of a wind turbine: 200KW turbine, 213ft tall, cost $900,000 (after MTC funds, cost is $400,000), payback is 5-6 years.
- Curriculum Development. MTC offers free resources for developing curriculum around renewable energy.
- Green Building. We have made contact with the CitySquare developer regarding green building practices. We plan on meeting with them in the next couple months. MassCHPS is another form of green building standard like LEED. It is for schools and stands for Mass Collaborative for High Performance Schools. Both LEED and MassCHPS standards are regarded by MTC as "green" efficient building. The Mass School Building Authority (MSBA) is trying to get communities to adopt MassCHPS standards for all new school projects (Jim is this correct?). In a pilot program, the goal was to beat energy code by 20%. This resulted in an increased cost of 3%, and when the rebates from utilities and MassCHPS were added in, the additional cost was less than 1%. The payback was 3 years. It is anticipated that if green building practices were used in CitySquare, the incremental cost would be 2-3%.

Tasks:
I don't have individualized tasks this time. The main thing we need to do is secure the City's commitments for these above projects. If you are close to one of these projects, please send along the information that we need to secure these commitments (i.e., who needs to be involved, procedures that should be followed, etc.).

Thank you to Jim and Tyler and to everyone who attended.

I strongly encourage you to check out MTC's website <http://www.masstech.org> to see case studies, maps and the resulting studies of projects funded by MTC.

Carissa Williams
Energy Consultant, City Of Worcester

May 24, 2006 - Energy Efficiency Sub-Committee Meeting Two

Hello Energy Efficiency Sub-Committee,
Thank you for attending our 2nd sub-committee meeting. In attendance: Bob Fiore, DPW; Peter Russo, National Grid; Jeff Lassey, WPS Facilities; Carissa Williams. Our next meeting will be on Wed. June 14 from 1:30-2:30pm at 76 E. Worcester Street (DPW) off of Shrewsbury St. in Worcester

In summary, our meeting served as a means for us to focus in on the emission reduction measures we want to pursue.

We decided to focus on:

- Getting all green (and maybe pedestrian) traffic signals switched over to LEDs, making it so that only yellow lights will be incandescent. NGRID has just rolled out a rebate for the green lights and can custom make a rebate for pedestrian lights if we prove it saves energy.
- Switching walkway lights over to the new QL lighting from Philips – lighting is very nice looking, last over 20 times longer which reduces maintenance costs, and saves energy and money. QL lighting reduces wattage from 270 watts to 85 watts and lasts 100,000 hours (current lighting lasts 4,140 hours)
- Choosing a city garage as a pilot for upgrading the lighting to fluorescent – garage lighting is typically on 24/7 so this would save a lot of energy and money. UMASS recently retrofitted their garage. Ameresco or Noresco could work with the city on this. NGRID would pay 80%. NGRID can offer a rebate for energy efficiency upgrades if over 5 years old.
- Communicate with the sewage treatment plant, UBWPAD, on their current renovation to ensure that energy efficiency is being considered and that they are in contact with Ngrid. Ngrid gives a rebate for fine-bubble aeration systems. Contact at Ngrid, Scott Farrell (sp?).
- Bob Fiore is taking the lead on looking further into the above ideas.

- Energy Efficiency policies: purchasing and behavior policies. There is currently a document that goes out with all bids and quotes stating Worcester's support for and request for recycled and environmentally preferred products. This was brought up by Bob Fiore and I looked into it with John Orrell. John doesn't think any bidder has ever taken advantage of it though. The document is attached.
- We looked at Arlington, MA's Green Building Policy and we had the question, what does PTBC stand for?. PTBC stands for Permanent Town Building Committee.
- I will be drafting some policies to send around.

- Continue with NGRID and other energy audits and rebates.
- Develop a more systematic way of scheduling energy audits
- Look into having a private company come in to audit all moderate to large size municipal buildings
- I will be putting together a list of the energy upgrades that have been done in the past three years, are currently being implemented or are planned for the future. Peter Russo and Jeff Lassey will be providing the information for this and assisting me.

- We would also like to look into energy efficiency audits/rebates from NSTAR as Ngrid can only offer rebates directly related to electricity. We have been missing this piece from our discussions and hope to get NSTAR back on board.

We have been discussing many energy audits and upgrades that Ngrid and/or the City are currently involved in, particularly within WPS.

Current Energy Audits / Upgrades

- Ngrid audit of DCU center
- Worcester East Middle School and City View – 2 firms have completed total lighting audits of these two schools
- 20 Irving Street – new chiller
- New chiller for city hall
- good time of year for chiller rebates
- Complete electricity audits by Ngrid of 7 larger schools
- Doherty – heat recovery rebate from NSTAR
- Taking a 2nd look at all schools – Ngrid? or NSTAR? (can anyone clarify this?)

On the renewable energy side, Bob Fiore reported that 2 weeks ago a methane collector was established at the Greenwood Street landfill (now unused) to test the methane levels for possible electricity production.

Thank you again for your input! See you next week for our Energy Task Force Meeting on June 7th.

-Carissa

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Carissa Williams
Energy Consultant, City Of Worcester

June 7, 2006 - ETF Meeting Three

Hello Energy Task Force,
Here are the minutes from our 3rd meeting, which took place on June 7th, 2006.

In attendance: Peggy Middaugh (REC), John Rugg (DPW Fleet), Bob Fiore (DPW), Eric Twickler (City Architect), Joe Zwirblia (Airport Commission), Jeff Lassey (WPS), Peter Russo (National Grid), Carissa Williams (Energy Consultant)

Our next meeting is Wed. July 26th 2:30-4pm at 76 EAST WORCESTER STREET. Please put this on your calendar. This will be my last meeting and we will be discussing the completed draft of the Climate Action Plan so it is very important for everyone to attend. I will send out the Climate Action Plan draft by July 17th so that you will have time to read it over beforehand.

Announcements:

- The EPA Healthy Communities grant went out on time. We will find out if we will receive funding early July.
- I will be representing Worcester at the ICLEI North American Congress in Chicago July 11-14. <http://northamericancongress.iclei.org/> for more details.
- There will be a Clean Energy Forum at Broad Meadow Brook (414 Massasoit Rd. Worcester) June 27th at 5:30pm. The forum will kick-off a Clean Energy Choice competition between Worcester Mayor Tim Murray and Salem Mayor Kim Driscoll. The first city with 100 new households to sign up for Clean Energy Choice wins. People will be able to sign up right at the forum!
- My last day is August 4th. I am moving to San Diego. The REC will begin looking for my replacement this week.

Reduction Target:

- We discussed setting a greenhouse gas emission reduction target - looking at what other cities have set, Worcester's emission data, and some quantified potential reduction measures. We decided that I would quantify the reduction measures that have happened or are still in effect from 2003 on, and then we would make a decision for a short-term municipal reduction target to propose to City Council.
- If we can not quantify soon enough, we will go with a conservative municipal target of 11% below 2002 levels by 2010.
- We all agreed that it was important to periodically update the target as time goes on, as emission reduction measures are implemented and there is more development, in order to set feasible goals that will also encourage the City to get closer and closer to attaining a level of GHG emissions that will not contribute to the threat of climate change.

Reduction Measures:

- We briefly went over the various reduction measures each sub-committee is working on and we got further into a select few.
- We discussed the use of biodiesel as a pilot and the use of B5 vs B20 (a higher amount of the "bio" part). There are some concerns that b20 will not work in cold weather, however, we have found that Keene, NH has used b20 for their entire diesel fleet for 3 years w/o one problem by using an anti-gel formula in the winter. Steve Russell, the Fleet Superintendent from Keene, will come to speak to the transportation sub-committee on Monday June 19th. Everyone is welcome to attend. One issue we must look into is the fuel efficiency of biodiesel vs. diesel.
- We discussed the energy audits and efficiency upgrades that have been done by Ngrid, including the new "green" voc school. All of these things can be quantified in cost savings, energy savings, and GHG emissions savings.
- I will be quantifying all of the potential and existing reductions measures in a chart format.

- We also talked briefly about employee incentives for public/alternative transportation and one suggestion was to offer reduced cost city employee bus passes.
- The new methane well in the old Greenwood St. Landfill was found to have 50% methane in the air being emitted. If this is found to be a steady stream, it is a potential source of energy. Other wells may be put in for testing as well. At the Barre landfill the methane emissions create heat for 200 households.

Data Collection:

- We reviewed the energy consumption 2002 data collected for my MA Thesis in 2004. I sent out my thesis, a summary energy profile, and the airport departments current energy data in an email yesterday as requested.
- We had a great discussion about data collection and creating a way for annual data collection from all departments. We discussed a web based form, but a more feasible option in the near term is for the energy officer to collect this data from the six main department heads. The idea is to create a simple form they can fill out each year and to create the knowledge that this data will be expected from them each year.
- It was agreed that the best way to collect this data is to collect form each main department, rather than going through purchasing. It was also suggested that individual departments should be able to give forecast data.
- Currently, there is no organized collection of interdepartmental energy consumption data in the City. There is also no organized method for tracking municipal energy audits and efficiency upgrades.
- It was agreed that it is of vital importance to track all municipal energy consumption data, energy audits, and reduction measures in an organized and updatable way on a yearly basis.
- I will need your help to collect all of this data and create simple data input forms in the next few weeks.

Thanks for reading!

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Carissa Williams
Energy Consultant, City Of Worcester

June 14, 2006 - Energy Efficiency Sub-Committee Meeting Three

Hi All,

Here are the minutes from our sub committee meeting on June 14th. In attendance: Bob Fiore, Rob Krueger, Carissa Williams. Missing: Peter Russo, Jeff Lassey, Brian Blood.

We discussed:

- Switching over all green and red traffic signals in the City to LEDs
- Doing a pilot lighting upgrade in a City garage – switching to fluorescent lighting and installing light and movement sensors to control use. Check with Health, Library, and Senior Center for possible pilot locations.
- The QL Phillips walkway lighting – ask Ngrid about QL Plan. Bob Fiore brought up the point that the QL light

bulbs are $100 each as compared to the high-pressure sodium vapor bulbs at $15. Though the QL lighting will decrease costs over time if it is allowed to run its life – we also have to consider instances when lighting becomes damaged or broken before it has burned out.

- The City adopting a Green Building Policy. Suggested I have Eric Twickler look at, which he has done – see attached.
- The City adopting an Energy Efficiency Policy. We read over a draft of an energy efficiency policy for Worcester. It was suggested we include LID (low-impact development). We had much discussion over how to implement such a policy; to make a policy such as this effective, it would require buy in from administration and staff. It was suggested that we get ideas from the people that would be responsible for the implementation of these policies for how to ensure effectiveness. We would need to have gatekeepers in each department and in purchasing. It was suggested that a simple check list could be created for these gatekeepers to help make their monitoring easier.
- We also looked over the Ngrid efficiency upgrade data and discussed getting the cost data. Bob Fiore, Ngrid, and Purchasing should be able to help with this.

Thanks!

Carissa Williams
Energy Consultant, City Of Worcester

June 19, 2006 - Transportation Sub-Committee Meeting Three

Hi All,
Thank you for attending our transportation sub-committee meeting on June 19th. Here are the meeting minutes.

Guest Speaker: Steve Russell, Fleet Manager in Keene, NH – B20 user.
Thanks Steve! Can you please send out the ppt you gave to everyone on this email?

We discussed:

- Biodiesel in Worcester. Steve Russell presented his experience with biodiesel. Keene, NH has been using B-20 in al vehicles year round for 3 years with no problems. They use an anti-gel formula in the cold weather months, which comes premixed from the biodiesel provider for no extra charge. Some things we discussed:
    - Oil samples before biodiesel were showing .6, .7, .9 in soot; oil samples in vehicles using biodiesel showed no soot.
    - Keene purchases from World Energy, contract with Fleming Oil, uses Artic Express, astm D-6751 standard certified.
    - Costs 5cents more per gallon

- Biodiesel manufacturers get Federal Credit of 20 cents per gallon.
- Dennis K Burke (city's fuel contractor) - biodiesel costs 15cents to 20 cents more.
- Put specs for biodiesel in next bid for fuel to get rid of this problem of overcharging for biodiesel.
- There is no state contract for biodiesel right now.
- The city buses in (Keene ?) are using biodiesel and are getting 2 miles more to the gallon.
- Some vehicles only warranty up to B-5, however, Keene has never had a problem.
- When you first start using biodiesel you must change the fuel filter often because the biodiesel cleans out the gunk.
- Keene State College did pilot with biodiesel and when the price went up they wanted to switch back to diesel – drivers refused because they felt better when driving on biodiesel.
- Dr. Melinda Treadmill did a real life study at Keene State College measuring the particulate matter 2.5 in biodeisel vs. diesel vehicles. Found that particluate matter (PM) is greatly reduced by using biodiesel. More study info available in ppt and form Steve Russell.
- Qualitative info from Steve that his drivers do not get as many headaches or complain of as many health problems.
- 2007 ULSD requirement will not effect biodiesel use.
- Professional Development / Info
- NAFA seminars / conferences
- Tom Lupis – spokesman at port authority (NJ? and JFK using biodiesel)
- NBB website – National Biodiesel Board

  Our conclusion is that Worcester should do a B-20 pilot with the ~12 diesel vehicles that fuel at the reservoir tank as well as switch over the cemetery tank. John Rugg said he would suggest this to the commissioner.

- Gathering fuel data. Collecting basic data for gallons of gas used and gallons of diesel for a fiscal year. I have this data for 30 departments (I think this is all depts) for the fy (04-05) and for fy (05-06 up to february when the data was collected). I am not sure if it is for gas or diesel. This data comes from Nicholas Marchese who can answer any questions about the data and also probably gave us more detailed data about specific vehicles. See data attached. We also discussed the current fuel tracking system that the City uses. John Rugg mentioned that the City does not currently track mileage because when they try to do this employees were not entering the correct mileage.
- Enabling the anti-idling 5 minute automatic shut off on DPW med-large trucks. John Rugg has brought this idea to the commissioner is checking with him to see where we are here.

Thanks again Steve for the great discussion!

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Carissa Williams

Energy Consultant, City Of Worcester

June 21, 2006 - Renewable Energy Sub-Committee Meeting Three

Hello Renewable Energy Sub-Committee and friends,
Thank you for attending our meeting on Wednesday, June 21st. In attendance: Carol Harley (CSG), Eric Twickler (City Architect), Joe Zwirblia (Airport Commission), Carissa Williams (Energy Consultant), Peggy Middaugh (REC), Kimberly Abraham (DPW, rep. of Phil Guerin), Bob Hoyt (Water Filtration Plant).

Guest Speaker: Ben Farmer, Alternative Energy Store – Ben can you send your ppt presentation out to us all? Can you also send the contact info for Emery Lovins of the Rocky Mountain Institute as you promised and remind me why you suggested we talk with him?
Agenda
Wednesday, June 21st from 10:00am to 11:30am
44 Front Street, Worcester, Suite 300

I. Solar Heat and Hot Water (10:00-10:40)
a. Presentation by Ben Farmer, Alternative Energy Store
b. Discussion – Solar Power in Worcester

We discussed solar hot water and solar heating options for the City. We are very interested in the cost effective energy options these technologies have to offer and would like to learn more from the Alternative energy store. Ben can you send a primer on costs, benefits, maintenance, installation needs, etc., particularly for municipalities or commercial operations on solar hot water and solar fresh air heating? Here are the two case studies Ben sent:
http://www.ci.newton.ma.us/sunergy/#ch1
http://www.eere.energy.gov/state_energy_program/case_study_by_topic_detail.cfm/cs_id=7

- Solar air heating is about 55-75% efficient and is low cost (payback ~4 years)
- Solar water heating is about 85% efficient (payback ~ 5-7 years)
- Solar electricity is only 16% efficient (payback 10-20 years)
- Solar air heating is completely self sufficient so you don't need to tie into existing systems. It contains a small electric solar pv panel to power the fan.
- For every 1000 sq. ft. you need to heat you need one 4' x 7' collector.
- 15 minutes of sunshine will bring the space to 70°
- Two kinds of solar heating – systems that heat the indoor air and systems that heat the outdoor air (fresh air systems).
- The fresh air systems can't heat well if the outside air is below 20°

- The city is required to do 6 air changes an hour in a public building
- Ben recommended the indoor heating system because of our climate; however, the fresh air system may help lesson the burden of 6 air changes an hour.
- The Alternative energy store works with Evergreen Solar – a solar manufacturer in Marlborough.
- One particular model (Ben do you remember which you were talking about? Can you give more details on this?) is highly efficient with 20% efficiency rather than the avg. of 12%. It is 1 panel that is 200 watts and measures 15" x 30".
- We talked about how South High can utilize these solar air and water technologies to lesson there high electric heat bill. South high has a plan to move to natural gas heating. However, using solar technologies would still lesson the heating cost.
- Solar air heating systems are meant to be a secondary heating system, reducing your use of oil, gas or electricity, but not eliminating it.
- Worcester should work to get solar hot water and heating in every school.
- We would also like to look into solar water heating for the water filtration plant which needs warmed water for eye washes and other things.
- Currently the water is electrically heated and costs a lot. Ben, you asked for a particular building to use when giving us a cost benefit proposal – please use the water filtration plant and let us know what info you need. Best to contact Bob Hoyt (hoytr@ci.worcester.ma.us) as my last week is next week.
- We also want to bring CDM in on the conversation about introducing renewable technologies into the water filtration plant.
- Solar hot water uses flat plate collectors and can heat up to 150°.
- We have to find out the needed high water temp. for washing school dishes.
- South high has a rubber roof which can be patched easy if needed for installation.
- We also (somewhat jokingly) discussed using solar panels as the skin on the new North High School. However, currently the skin costs $20/sq ft. which is more than it would cost to line outside of the building with solar heat collectors.

II. Renewable Energy Purchasing (10:40-11:00)

a. Overview and familiarize everyone with RECs

b. Discuss potential purchasing contract with Mass Energy

c. Discuss other options – bundled product, etc.

I explained the process of REC creation and purchasing – and the economics behind it. We discussed making the $20,000 purchase of RECs from Mass Energy, which the City would get back in their Clean Energy Choice fund to spend on implementing the great projects we have been discussing these past months.

III. Other Renewable Energy Items (11:00-11:40)

a. Update on

- Wind Power at Crow Hill or Greenwood Street Landfill
- Methane at Greenwood
- Solar PV at Voc School or Water Filtration Plant
- Hydro at Sewage Treatment Plant or Water Filtration Plant

b. What will go in the plan?

We are still looking into wind power and solar at the water filtration plant. We will contact the Voc school in the fall to discuss getting solar panels installed there. The new methane pump at the old Greenwood Street landfill is producing 50% methane – it will continue to be monitored and other pumps may be installed. The director of the UBWPAD thought that there was not enough head for installing hydro power at the sewage treatment plant. However, I have made contact with a company that specializes in hydro power at sewage and water treatment facilities. Also, the City of San Diego has installed hydro power at their sewage treatment plant, so we could get a case study from them.

The Draft Climate Action Plan being written now will include the preliminary ideas we have had but will acknowledge that more in depth analysis must be done and that other ideas may be looked at.

IV. Wrap Up (11:20-11:30)

a. Next Steps

We decided to have our next Energy Task Force meeting at the water filtration plant and tour the plant. We also thought it was a good idea to plan other meetings at different field trip sites. Another field trip site we thought of is the (LEED?) Blackstone Valley school in Upton. It would also be beneficial to tour MassEnergy's wind turbines.

Thanks Everyone! Keep moving forward!

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Carissa Williams

Energy Consultant, City Of Worcester

Appendix E: Data Assumptions and Calculations

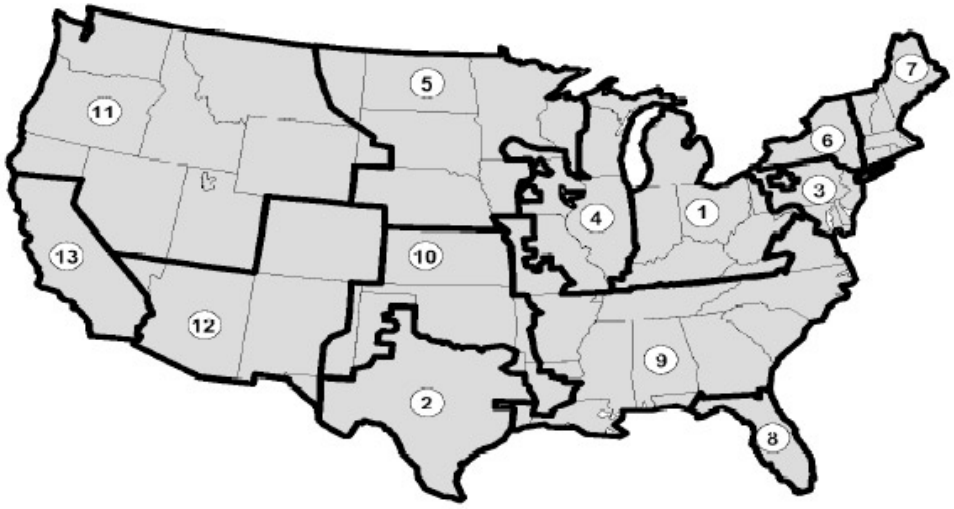
Emissions data for Worcester's GHG Emissions Inventory and the measures included in this Climate Action Plan were quantified using the Clean Air and Climate Protection Software (CACPS) Version 1.0 June 2003, a product created for ICLEI to assist local communities with the CCP process. This software was developed by Torrie Smith Associates (TSA) for Cities for Climate Protection – U.S. Projects, the U.S. State and Territorial Air Pollution Program Administrators (STAPPA) and the Association of Local Air Pollution Control Officials (ALAPCO). It derives emissions of greenhouse gases and criteria air pollutants, namely nitrogen oxides (NO_X), sulfur oxides (SO_X), carbon monoxide (CO), volatile organic compounds (VOCs) and coarse particulate matter (PM_{10}). These emissions are computed by algorithms that take as input the type and amount of fuel used, which is input by the user, and the appropriate emission factors.

Emission Factors

The emission factors are used by the software to determine the emissions caused by fuel usage. There is a coefficients menu where the user can choose from predefined emission factors or can define his or her own. What follows is a description of the emission factors used in our data generation.

Average Grid Electricity – These are the emission factors for the annual average kilowatt-hour on the grid in the North American Electricity Reliability Council (NERC) region that the user specifies. In our case, we use the Northeast Power Coordinating Council (NPCC), New England Subregion (see Figure 6). Emission factors are derived by dividing the actual emissions (or estimated in the case of CH4 and N2O) in the NERC region by the kilowatt-hours used in that region. Emission factors are provided for every year from 1990 through 2020.

North American Electricity Reliability Council (NERC) Regions



1 ECAR – East Central Area Reliability Council
2 ERCOT -- Electric Reliability Council of Texas
3 MAAC -- Mid Atlantic Area Council
4 MAIN – Mid America Interconnected Network Inc.
5 MAPP – Mid-Continent Area Power Pool
6 NPCC – Northeast Power Coordinating Council, NEW YORK Subregion
7 NPCC -- Northeast Power Coordinating Council, NEW ENGLAND Subregion
8 SERC -- Southeastern Electric Reliability Council, FLORIDA (FRCC)
9 SERC -- Southeastern Electric Reliability Council, EXCLUDING Florida

7) NPCC -- Northeast Power Coordinating Council, NEW ENGLAND Subregion

The software recommends using the Average Grid Electricity coefficient for the inventory and overall reduction measures. However, a Marginal Grid Electricity factor is also provided. Marginal kilowatt-hours are those used during peak energy demand times, when the greatest number of energy-generating plants are online. Typically, the highest polluting plants are put online last; therefore, when energy demand is the highest, more plants are put online and emissions per kilowatt-hour become higher than the average. Marginal emission factors represent the emissions generated by the electricity source or sources used to produce the last kilowatt-hour of electricity demanded at any given time. Though the Marginal Grid Electricity factor should not be used for the inventory, it can be useful to realize the impacts of a reduction measure when the measure's effects on electricity demand (including when it influences demand) and supply is well understood.

RCI Average – These are the emission factors (except for carbon dioxide) for fuels used in the Residential, Commercial and Industrial sectors (RCI), assuming an average mix of technologies. These emission factors represent the typical emissions of air pollutants associated with the burning of the fuels listed. In some cases, the emission factors vary by sector (e.g. emissions for fuel oil are different in the Industrial than the Residential sector). Greenhouse gas emission factors by fuel type are taken from the International Panel on Climate Change (IPCC 1996). The GHG emission factors for each sector are converted from units of kg/TJ to lb/mmbtu and applied to 1990 and 1999

through 2020.

The software recommends using the RCI Average emission factors in both the Community Analysis and Government Analysis. They can also be used in the Measures sections, but RCI Specific emission factors are generally more useful in these sections. The RCI Specific emission factors are emission factors (except for CO2) for specified combinations of fuels and technologies used in the Residential, Commercial and Industrial sectors.

Transport Average – These are the emission factors (except for CO2) that specify both the average vehicle fuel efficiency and average emissions per mile for particular classes of vehicles when using particular fuels (e.g. gasoline powered mid-size autos). Average emission factors for a fleet of vehicles depend on the likely mix of vehicle technologies, fuels, and age. Because the characteristics of the on-road fleet are constantly changing, values are provided for each vehicle type for the years from 1990 through 2020. These values are based on historical and simulated future evolution of the on-road fleet in the U.S. The main sources for the Transport Average emission factors are the U.S. Environmental Protection Agency (EPA) and U.S. EIA.

Fuel CO2 Emission Factors – These are the emission factors for carbon dioxide for all fuels except electricity. As carbon dioxide emissions vary only with the type and amount of fuel consumption and do not vary significantly with either combustion or mitigation technology, they are kept as a separate set of emission factors. The software contains one CO2 emission factor for each particular fuel, and these factors have been selected to be consistent with government information sources in the U.S. The main source for CO2 emission coefficients is the 1605 Voluntary GHG Emissions Reporting Guidelines produced by the Department Of Energy (DOE) in 2001 (http://www.eia.doe.gov/oiaf/1605/ggrpt/). For fuels for which U.S. values are not readily available, the primary source of emission factors is the IPCC default emission factors supplied in the 1996 Revised Reporting Guidelines on Greenhouse Gas Emissions.

Waste Coefficients – These are the emission factors used for quantifying the emissions from waste in the Analysis modules and for quantifying the greenhouse gas impacts of waste measures in the Measures Modules. The emission factors vary based on type of waste and disposal method. The source of the waste emission factors is research by the EPA; waste emission factors were last updated August 2002.

Waste In Place – In the Waste-In-Place method, landfill methane emissions are estimated based on the accumulated waste in the landfill, as opposed to the current year's generation of waste. This method is often used in national and state inventories of greenhouse gas emissions. This method calculates emissions based on the amount of waste in the landfill less the amount of gas recovered. The waste-in-place method is appropriate for approximating the amount of landfill gas available for flaring, heat recovery or power generation projects.

For a particular amount of waste-in-place (WIP) at a landfill, the simplifying assumption is made that the waste was deposited in the landfill in equal installments for each of the years the landfill was open. Then the methane generated in the current year (before recovery) can be estimated as::

$$k * L_o * R_n * WIP * \frac{\exp^{-kA} - \exp^{-kB}}{\exp^{-k} - 1}$$

where k is the exponential time constant of decay. It has a default value of 0.05 but this value can be modified by clicking on the Settings button in the Waste In Place module.

Lo is the methagenic potential of the waste, expressed in cubic meters of methane per kg of waste if you are using the System International unit set and in cubic feet of methane per pound of waste if you selected the American Standard unit set when you first started the software. It has a default value of 0.17 cubic meters of methane per kg of waste (or 2.72 cubic feet per pound in Standard American units) and this value can be modified by clicking on the Settings button in the Waste In Place module.

WIP is the total waste-in-place in the landfill as of the year you are analyzing, input in tonnes if you are using the Metric unit set and in tons if you are using the American Standard set.

Rn is a factor that incorporates the density of methane and any unit conversions required to balance the equation dimensionally

A is the difference between the current year (plus one) and year the landfill was opened

B is the difference between the current year (plus one) and the last year waste was deposited in the landfill.

Reduction Measure Data Sources, Assumptions, and Software Inputs

General

35.72867 kWh/day/American
0.02999 lbs CO_2/basketball
2710 stairs/kWh for a 140 lb person
.9142 lbs CO_2/mile
Source: www.soltrex.com

Existing Building Energy Upgrades

Inputs:
Grid Average Electricity Reduction 767,863 kWh (see NGrid spreadsheet on upgrades from 2002-2006)
Cost Savings: $0.13/kWh (includes distribution costs; data from Fire Dept. energy use and cost spreadsheets)
Implementation Cost: $370,467 (see NGrid spreadsheet - data from NGrid and City Depts.)

Upgrade Red Traffic Lights to LEDs

1,400 red traffic light (DPW) 1997 switched all to LEDs after a test at one intersection showed a 84% reduction in watts/bulb and a 58% reduction in total energy cost (DPW). Assume red lights are on 11 hours/day (based on DPW information that red and green lights are pretty much on 50/50 with yellow on a few percentages). Assume incandescent red lights are 100w making LED red light 16w (supported by data).

Savings of 84watts/bulb * 1,400 bulbs * 11hours/day * 365 days/year) / 1000wh/kWh = 472,164 kWh reduced
Assume traffic light electricity costs $0.08/kWh (but this could be more)

Inputs:
Grid Avg. electricity reduced 472,164 kWh
Cost: $0.08

Upgrade 200 Exit Signs from Incandescent Lights to LEDs

Incandescent 40 watts (CSG, energystar, inform.org), LED 2 watts (CSG. inform.org) (5 watts energy star). Assumes 200 signs on 365 days a year 24 hours/day

per fixture cost $25 ($22 for retrofit from specialty-lights.com, $28 for new over 50 w/battery backup red or green, $24-$40 grainger.com and good mart) $10 installation charge (inform.org) NGrid rebate $20/fixture (Peter Russo-NGrid)

Energy Reduction = 40w-5w = 35w. (35w * 24hr/day * 200 * 365days/yr)/1000wh/kWh = 61,320 kWh reduced
Inputs: Energy Reduction Grid Average 61,320 kwh
Cost: $0.13
Implementation Cost: 25+10-20 = 15 *200 = 3,000

Increase the Efficiency of Lighting in the Pearl/Elm Garage

FY04 Electricity data (Select Energy) from Pearl Elm Garage at 20 Pearl Street used. 484880 kWh used in FY04. Fluorescent lighting reduce energy use when switching from High Pressure Sodium Vapor by 35-50% (NGrid), 59% in Harvard case, 78.7% (holophane) (use 50%). 482880 kWh * .5 = 241440 kWh

Inputs: 205224 Grid Average kWh reduced
Cost: $0.13/kWh (2006 avg. supply and distribution costs - fire dept. bills)

Fixture cost ~$200 and installation about $50 (NGrid), rebate is $130. Cost per fixture is $120
Implementation Cost: $120 * 369 lights = $44,280

369 lights assumes lights are on 16 hours every day assume each high pressure sodium lights 150 watts (holophane.com) 150w * 365* 16hours/day / 1000wh/kwh = 876 kwh/day/fixture
482880 kwh/year / 876 kwh/day/fixture = 369 lights.

Change-A-Light Campaign

Assumes each household changes one incandescent to a LED. Assumes 63,509 households from US Census 2005 data. Assumes energy savings per bulb is 103 kWh /yr (data from energy star CFL Calculator http://www.energystar.gov/index.cfm?c=cfls.pr_cfls).

Inputs: Grid Average Energy Reduction = 63509 * 103 = 6,541,427 kwh
Cost savings: $0.15935/kWh (National Grid's Residential Basic current rate - see table below)
not input but cost savings also result from longer lifetime of LEDs.

Basic Supply Charge (11/1/06-4/30/07)	11.616 ¢/kWh
Distribution Charge	2.484 ¢/kWh
Transmission Charge	0.999 ¢/kWh
Transition Charge	0.536 ¢/kWh
Demand Side Management Charge	0.25 ¢/kWh
Renewables Charge	0.05 ¢/kWh
TOTAL	15.935 ¢/kWh

Promote Clean Energy Choice

Measure shows 10% of households switching to 100% clean energy (or any combination equaling 10% of electricity use). Savings represents the amount of money the CIty would receive from MTC in Matching funds assuming all 100% sign ups. This does not include the second pot of matching funds for low income areas. 2002 Residential Electricity consumption = 403,821,151kWh (MassElectric). Growth rate for res. elec. consumption from 1997-2002 = .024 (figured from actual 1997 and 2002 MassElectric data). 2006 est residential electricity consumption = 444,006,051. 10% = 44,400,605 kWh.

For every kWh, .0125 dollars (average of two one-hundred percent options) extra is paid.
If 50% options are included the average extra price/kwh is .01338. (If 20% of households switched to 50% clean energy this would still be 10% of electric use and extra cost would be .01338 / kWh.

Percent of extra cost matched by MTC is 58.5% (average of 2 100% options). 58.5% of .0125 = .0073. So on average, .0073 dollars/kWh on clean energy goes to CIty. If all four option are included (50 and 100%) 60.75% is the percent matched by MTC of .01338 dollars/kWh. 60.75% of .01338 = .0081 dollars/kWh to the city.

Inputs: Initial, Grid Average Elec = 44,400,605 kWh
Cost: .0073/kwh (to represent money to city)

Purchase Renewable Energy Certificates

$30 per Mwh - buys 833 Mwh for $24,990 (Estimate from Mass Energy)

Install Hydro-Power at the Water Filtration Plant

100KW System - operating at 90% constantly. Capacity at water treatment plant is between 99.7KW and 109KW based on two simple equations. Uses head of 55ft and 23MGD. Kwh Cost from findsolar.com.
90KW * 365days/yr * 24hrs/day = 788400kwh/yr

Inputs:
grid avg 788400 kwh
Cost: $.08/kwh (water dept. bills)
green electricity 788400 kwh
Cost: 0
Implementation Cost: 300,000 (estimated from utility warehouse equipment price of $55,000 for 100KW system designed for 433ft head.)

Solar Heat at Schools and Airport

60kwh/sq ft of heat panel generated annually (Alternative Energy Store). 106 sq ft panel, cost $2,788 (Alternative Energy Store). Cost per therm $1.57 based on CIty of Worcester Fuel Bills (fire dept); $1.34 based on Airport fuel billls.
Assume heat with natural gas.
60kwh/sqft * 106sqft = 6360 kWh = 217 therms

Inputs:
Current: Natural Gas 217 therms
Cost: 1.57/therm or 1.34/therm for airport
Replacement: Solar 6360kWh

Cost: 0
Implementation cost: $2,788 (equipment cost only)

Solar Hot Water at Water Filtration Plant

Based on project at Chickasaw National Rec Area, Oklahoma - 484 sq ft = 1500 gal/day at least 105°. 579 hours/year under 105 (solar only source of hot water).

Inputs:
Current: Grid Avg. Electricity 18,194 kwh (amount saved/yr at Chickasaw (U.S. Dept of Energy www.eere.energy.gov)
Cost: $0.08/ kwh (water dept. bills)
Replacement: Solar 18,194 kwh/year
Cost: 0
Implementation Cost: $24,000 (total cost)

Wind Power at North High

250KW turbine - 50m high tall. Assume wind speed of 6m/s. Kwh estimated from MTC.

Inputs:
Current: Grid Avg 400,000 kWh (Est MTC)
Cost: $.13/kwh
Replacement: Wind Power (Green Electricity) 400,000 kWh
Cost : 0
Implementation Cost: $1,000,000 (Est from MTC) does not include rebates - potentially of $500,000

Solar Electricity at the New Vocational School

Estimated cost after MTC rebate. If building was leed or energy star certified, MTC rebate would be an additional 3,000 for a 2KW system. Power generation estimated from similar systems found on soltrex.com.

Inputs:
Current: Grid Avg. 3,000 kWh (soltrex.com)
Cost: $.13/kwh
Replacement: Solar 3,000 kWh
Cost: 0
Implementation Cost: 8,000 (estimated from MTC $10/watt, 2KW system = 20,000, subtract MTC rebate of ~$6/watt) (may be just for equipment)

Solar Heat at the Sewage Treatment Plant

60 kwh/sq ft of heat panel generated annually (Alternative Energy Store). 106 sq ft panel, cost $2,788 (Alternative Energy Store). Assume heat with natural gas.
60kwh/sqft * 106sqft = 6360 kWh = 217 therms

Inputs:
Current: Natural Gas 217 therms
Cost per therm $1.48 based on Sewage treatment plant Fuel data.
Replacement: Solar 6360 kWh
Cost: 0

Implementation cost: $2,788 (equipment cost only)

Potential Electricity Generation from Methane at Greenwood Street Landfill

Based on CACPS methane generation in 2010. This is calculated with the waste in place measure taking inputs of 2,150,000 tons of waste dumped from 1973 through 1985. (DEP Final Inspection Prioritization Report for the Worcester Landfill, dated April 17, 1998).

Assumes 75% methane recovery rate (suggestion of software if recovery rate is unknown). Assumes 75% of methane generated (1,948 tons) can produce 27,283,680 kWh (www.epa.gov/cmop/resources.converter.html updated Oct 4, 2006)

Enable 5-Minute Shut-Off in Trucks

Approx. 270 Diesel Trucks (170 Diesel in data, 200 unknown - assume half are diesel). Use for 170 vehicles 139404.9 gallons/FY06 (Nick Marchese).
Assume each vehicle idles for 20 minutes twice a work day.
Enabling the 5-minute shutoff will reduce idling by .5 hour each work day per vehicle.

.5hr * 270 vehicles * 260 work days/year = 35100 hours idling reduced/yr.
Each hour of idling uses 1.8 gallons of diesel (ICLEI)
35100hours/yr * 1.8 gallons/hr = 63180 gallons/year reduced
139404.9 - 63180 = 76224.9

Inputs:
Current: ULSD Diesel Heavy Truck 139404.9 gallons
Cost: $2.06 /gallon (Dennis K. Burke via John Rugg. FYO6 DPW data has price at $1.83)
Replacement: ulsd Diesel Heavy truck 76224.9 gallons
Cost: $2.06

Increase Fuel Efficiency of Vehicle Fleet

Mid-Size

From 20.9 MPG to 28 MPG for mid size car. Data from 97 gasoline vehicles in class 1. 20.9mpg software assumption. Data split in half for full size and mid-size. 48337 gallon gasoline used in class 1 (DPW FY06 data).

Inputs:
Before: gasoline auto mid 24168.5 gallons (DPW FY06 data) = (505560 vmt)
Cost: $1.69 (DPW FY06 data)
Fuel Efficiency: 20.9mpg (software)
Replace: Gasoline auto mid 505560 vmt
Cost: $1.69 / gallon
Fuel Efficiency : 28 mpg (feasible improvement)

Full-Size

From 19.5 MPG to 22 MPG for full size car. Data from 97 gasoline vehicles in class 1. 19.5mpg software assumption. Data split in half for full size and mid-size. 48337 gallon gasoline used in class 1 (DPW FY06 data).

Inputs:

Before: gasoline auto full 24168.5 gallons (DPW FY06 data) = (471243 vmt)
Cost: $1.69 (DPW FY06 data)
Fuel Efficiency: 19.5mpg (software)
Replace: Gasoline auto full 471243 vmt
Cost: $1.69 / gallon
Fuel Efficiency : 22 mpg (feasible improvement)

SUV

From 14 MPG to 22 MPG for SUV/Pickups. Data from 49 gasoline vehicles in Class 2. 14mpg software assumption.

Inputs:
Before: Gasoline light truck 35411.2 gallons (DPW FY06 data) = (495754 vmt)
Cost: $1.69 (DPW FY06 data)
Fuel Efficiency: 14mpg (software)
Replace: Gasoline light truck 495754 vmt
Cost: $1.69 / gallon
Fuel Efficiency : 22 mpg (feasible improvement)

Biodiesel (B-20) Pilot Program

5 diesel vehicles and 3 large cutting machines fuel at Hope. 1,965 gallons of diesel used/year (Hope Cemetery - Donna Berrios FY05)
Dennis K Burke via John Rugg (October 2006: ULSD 2.06, Diesel 2.05, Biodiesel 2.68)

Inputs:
Use before: 1,965 gallons Diesel (Heavy Truck)
Cost: $2.06
Use After: 1,965 gallons B-20 (Heavy Truck)
Cost: $2.68

Increase Employee Carpooling

Assume 4,110 employees (www.city-data.com) (includes schools).
Extrapolate city-wide commute data from US Census 2005 to city employees. Drive alone (83%) = 3411, Carpool (9%) = 370, public transport (3%) = 123, Walked (3%) = 123, Other Means (2%) = 82, Worked at Home (1%) = 41.

Avg. trip distance for drivers is 19.5 (weighted average from BWC report).
19.5miles * 3411 *2 = 133029 miles driven alone each day * 260 (#of work days/yr) = 34587540

Inputs:
Current VMT: 34587540 miles/yr driven by solos (Auto Full-Size)
Cost: $2.40/us gal ($.123/vmt)
Vehicle Occupancy = 1
Replacement VMT: (Assume half of solos join up so that 3/4 of vmt are driven) 34587540 *.75 = 25,940,655 vmt/yr (auto full size)
Cost: $2.40/us gal
Vehicle Occupancy: 1.3

Offer Employee Telecommuting

1/8 of city employees who drive alone telecommute one day/week.
Assume 4,110 employees (www.city-data.com) (includes schools).
Extrapolate city-wide commute data from US Census 2005 to city employees. Drive alone (83%) = 3411, Carpool (9%) = 370, public transport (3%) = 123, Walked (3%) = 123, Other Means (2%) = 82, Worked at Home (1%) = 41.

Avg. trip distance for drivers is 19.5 (weighted average from BWC report).
3411/8 = 426.375 people switch to telecommute
19.5miles * 426 *2 = 16614 miles driven alone each day * 50 (#days/yr telecommuting) = 830700

Inputs:
Current VMT: 830,700 miles/yr reduced (Auto Full-Size)
Cost: $2.40/us gal ($.123/vmt)
Vehicle Occupancy = 1
Replacement VMT: 0

Increase Employee Commuters Traveling by Public Transport/Biking/Walking

1/8 of city employees who drive alone switch to public transport, walking or biking.
Assume 4,110 employees (www.city-data.com) (includes schools).
Extrapolate city-wide commute data from US Census 2005 to city employees. Drive alone (83%) = 3411, Carpool (9%) = 370, public transport (3%) = 123, Walked (3%) = 123, Other Means (2%) = 82, Worked at Home (1%) = 41.

Avg. trip distance for drivers is 19.5 (weighted average from BWC report - "Do Employee Commuter Benefits Reduce Vehicle Emissions and Fuel Consumption? Results of the Fall 2004 Best Workplaces for Commuters Survey". Revised November 14, 2005. Collaboration of U.S. Environmental Protection Agency and NuStats. Erik Herzog, Stacey Bricka, Lucie Audette, Jeffra Rockwell).
3411/8 = 426.375 people switch
19.5miles * 426 *2 = 16614 miles driven alone each day * 260 (work #days/yr) = 4319640

Inputs:
Current VMT: 4319640 miles/yr reduced (Auto Full-Size)
Cost: $2.40/us gal ($.123/vmt)
Vehicle Occupancy = 1
Replacement VMT: 0

Curb-Side Recycling

Data from DPW.

Encourage Recycling at Apartment Complexes

Assumes 15,000 households in complexes that the City does not collect from (DPW). .21 tons is the average that is recycled/household. 2005 tons of waste = 36,599. Recycling = 9,735. 9735/47350 = .21 tons

Inputs:
Mixed recyclables = .21 tons * 15000 = 3150 tons

Cost = cost the city pays $36.52/ ton.

This does not include a potential increase in recycling rate.

City-Wide Composting

75,000 cubic yards (20,000 tons). Data from DPW for 2005.

Recycle at Schools

Category % of Waste Stream based on 1999 data from Alameda City Unified public schools in California (www.ciwmb.ca.gov/Profiles/ Integrated Waste Management Board)

Data broken down by paper, glass, metal, plastic, organics (food, leaves, grass, etc), C&D, Hazardous, Special (Tires), Mixed Residue and further broken down into sub categories.

Totals for Worcester: 4903 tons (FY 06 DPW) Paper (47%) = 2304.4 tons, Glass (1.6%) = 78.4 tons, Metal (4.2%) = 205.9 tons, Plastic (12.3%) = 603.1 tons, Organics (31.5%) = 1544.4 tons, Food (20% part of organics) = 980.6 tons, C&D (2.3%) = 112.8 tons, Hazardous (1.4%) = 68.6 tons, Special (tires .2%) = 9.8 tons, Mixed (.8%) = 39.2 tons

Recycling for paper, plastic, metal, and glass and composting food would reduce waste by 4172.4 tons. Hazardous, tires, yard waste and C&D should already be taken out of the waste stream but, if they are not, they also should be recycled/disposed of properly.

Inputs:
Waste Reduced Mixed Recyclables = 4172.4 tons
Cost = $36.52 / ton (current 2006 cost for Worcester city, DPW).

Increase Residential Recycling Rate

Currently Recycling is 26.6% of our waste (9735 tons recycling / 36599 tons total waste, data from DPW 2005). If increased to 50% would prevent 8,564.5 additional tons from incinerator (36599/2 = 18299.5, 18299.5 - 9735 (current tons of recycling) = 8564.5 additional tons recycled.

Inputs:
Mixed recyclables reduction of waste = 8564.5 tons
Cost = $36.52 / ton (DPW 2006)

Cost will drastically increase in 2007 when Wheelabrator contract expires.

Emissions Inventory Data Sources, Assumptions, and Software Inputs (From Creating a GHG Emissions Inventory for Worcester, 2004, C. Williams)

(References within this section are to that document)

Electricity Data

Mass Electric is the sole electricity supplier for the City of Worcester. We received electricity usage data from Mass Electric employee Mike Thompson, Account Executive for Worcester-South. Electricity is measured in kilowatt-hours (kWh). Our data are for kilowatt-hours per year for the years from 1997 to 2002, broken into categories of Residential, Commercial/Industrial/Municipal, Streetlights, and Sales for Resale. Sales for Resale is the amount of electricity produced by entities in Worcester and bought by Mass Electric.

The Residential category is determined by the rate class assigned by Mass Electric. According to Thompson, "any customer on the Residential rate falls into this [Residential] category. Besides the obvious homes and apartments, some churches and farms, and small businesses are also on the Residential rate (pers. com. 2003)." All non-residential accounts are classified as Commercial, which actually includes Commercial, Industrial and Municipal use. Mass Electric does not track these in any more detail. In addition to the total kilowatt-hours per year, we also know the number of accounts, average usage per account, and, for 2001 and 2002, the amount paid for such electricity (see Appendix B, Table 1 for raw data from Mass Electric and Table 2 for the calculation of avg. use per account).

To separate out the Municipal use into its own category, we contacted City Purchasing Director, John Orrell, who puts us in touch with Tom Flaherty, the Regional Account Executive for Select Energy. Select Energy currently has the energy contract with the City of Worcester, and works in collaboration with Mass Electric and NSTAR.

Flaherty supplied us with the kilowatt-hours consumed from May 7, 2003 to November 11, 2003 broken down by the billed departments. There are six billed departments for Worcester's natural gas and electricity: Department of Public Works (DPW), Fire Department, Police Department, Airport, Parks and Recreation Department, and School Department. Flaherty also supplied us with the average monthly usage of kilowatt-hours per city account (i.e. per building or lighting section), which proved to be much more helpful information (see Appendix B, Table 3). Flaherty assumes that this monthly average is derived from actual kilowatt-hours used in 2002.

Because we have access to each account's monthly average, not only are we able to estimate the municipality's total yearly electricity use, we can also separate the electricity used for lighting (i.e. streetlights, traffic lights, and recreational lights) from that used for buildings, and we can see which buildings are the biggest users. We are able to separate types of buildings as well. Since we see that schools are responsible for most of the municipality's electricity use, we separate out the schools' electricity use from the other Municipal buildings (see Appendix B, Table 5).

As mentioned above, street lighting is a part of the Municipal usage. We obtained the exact amount of electricity used by streetlights in Worcester in 2002 from Mass Electric and used this data to separate out

electricity used by streetlights from that used by traffic and recreational lights (see Appendix B, Table 5).

We subtract the kilowatt-hours used by the municipality from the kilowatt-hours in the Comm/Indust/Mun category from Mass Electric to obtain the kilowatt-hours used by the Comm/Indust sector (see Appendix B, Table 6).

Natural Gas Data

Like Mass Electric, NSTAR is Worcester's sole supplier of its product, natural gas. We collect natural gas data from Robert Koster, Electric & Gas Forecasting. Natural gas use is measured in therms[1]. We have total therms data for the year 2002 broken into categories of Residential, Commercial, Municipal, Industrial, and Other. We also know the number of accounts in each category; therefore, we divide the total number of therms used in each category by the number of accounts to derive the average therms used per account (see Appendix B, Table 8). We illustrate this calculation for the Residential category in Table 3 below. Raw numbers throughout this text are shaded with gray.

Category	Total Accounts	Total Therms	Average Therms Per Account
Residential	37,949	39,986,711	1,054

Table 3. Calculation of Avg. Therms per Account

(total therms) 39,986,711 / (# of accounts) 37,949 =
1,054 (avg. therms/account)
(Equation 1)

NSTAR defines these categories in a manner consistent with the definitions from the U.S. Bureau of Labor Statistics. Customers are classified as Commercial if their primary business activity is any of the following: agriculture, wholesale trade, retail trade, finance, insurance, real estate, or service industries. Churches, synagogues and other places of worship are included in the Commercial category. Customers are classified as Industrial if their primary business activity is any of the following: mineral industries, construction industries, manufacturing, transportation, communications, or utilities. The Municipal category represents state government as well as local government. It includes public colleges and universities (i.e. state and community schools) while private schools are included under Commercial.

The Residential category is further broken down into accounts that use natural gas for heating and those that do not. The data are estimated from the entire Worcester division, defined by NSTAR to include Worcester and the 11 surrounding towns of Sterling, Boylston, West Boylston, Shrewsbury, Grafton, Upton, Holden, Millbury, Sutton, Leicester, and Auburn. The total therms used by Worcester account for 56% of the therms used by the entire division. In the division, 5.5% of residences are non-heating so we apply this percentage to the accounts in Worcester to get the number of residences in Worcester that use natural gas only for purposes other than space heating. Non-heating residences, while representing 5.48% of accounts, use a significantly smaller percentage (1.22%) of the total therms.

Category	Total Accounts	Total Therms	Average Therms per Household
Residential	37949	39986711	1054
Heating	35870	39498873	1101
Non-Heating	2080	487838	235

Table 4. Calculation of Natural Gas Heating and Non-Heating Residences

(total residential accounts) 37,949 * .0548 (% of accounts that are non-heating) = 2080 (non-heating accounts)

(Equation 2)

(total residential therms) 39,986,711 * .0122 (% of therms that non-heating accounts use) = 487,838 (total therms used by non-heating accounts)

(Equation 3)

Therefore, the average therms used by a non-heating residence are approximately 79% less than the number of therms used by a residence that uses natural gas for space heating.

235 therms / 1101 therms = 0.21

(Equation 4)

100 – 21 = 79

(Equation 5)

We obtained data on local government consumption of natural gas through Select Energy. Flaherty gave us decatherms for the 2003 fiscal year (July 1, 2002 – June 30, 2003) broken down by department billed: Police Department, Fire Department, Airport, Department of Public Works (DPW), School Department, and the Parks and Recreation Department (see Appendix B, Table 9).

Heating Oil Data

We estimate the heating oil used by the City of Worcester. Unlike gas and electricity, oil in Worcester comes from numerous suppliers, and it is not feasible to contact and gather information from all of them. The Energy Information Association (EIA) estimates heating oil usage in New England to be an average of 825 gallons per household (EIA 2004). We multiply this value by the number of households in Worcester heated with oil according to the 2000 US census (US Census 2004) (see Appendix B, Table 14).

14,919 (# of households heated with oil in 2000) * 825 (annual gallons of oil per household) =

12,308,175 (gallons of oil used by the Residential sector in Worcester in 2000)

(Equation 6)

Originally we estimated the number of households heated by oil in 2002 in the following way. First, we gathered information from City Assessor, Robert Allard, on number of single family houses, single family condos, two-family units, and three-family units. The city lacks data on large apartment complexes and hence they are

not considered in our data. Second, we added up the above numbers to obtain the total number of households (see Appendix B, Table 11). Third, we subtracted the number of households using natural gas for heating (a number collected from NSTAR) as well as an estimated number of households with electric heat (derived from data gathered from the city assessor). We assume that the remaining households are heated with oil (see Appendix B, Table 13).

We estimate the number of households heated by electricity for our original calculation as follows: Allard provides numbers of single, two and three family homes heated by electricity. We then apply percentage of these homes heated with electricity, as opposed to forced hot air, steam, or forced hot water, to our total households' number as described above to get an estimated number of total households heated by electricity in the city (see Appendix B, Tables 12 and 12a).

For the Commercial/Industrial sector, we estimate fuel oil use from a document titled "Fuel Oil and Kerosene Sales 2002" produced by the EIA (2003). A chart in this publication shows Commercial, Industrial, and Residential distillate oil use for 2001 and 2002 by state (see Appendix B. Table 15). This tells us that in Massachusetts in 2002 the ratio of combined Commercial and Industrial use (in gallons) to Residential use is 0.185 or 18.5%. Extrapolating this percentage to Worcester, Residential heating oil used is multiplied by 0.185 to obtain the number of gallons used by the Commercial/Industrial sector in 2002 (see Appendix B, Table 16).

The Municipal use of heating oil is the only statistic that does not require estimation. We collected the data from the City Buyer, Bernie Schofield, who obtained the numbers from the vendor, Peterson Oil. The data are for the time period from October 2002 to October 2003 (see Appendix B, Table 17).

Transportation Data

Gasoline

The amount of gasoline fuel used by the entire City of Worcester is determined by the CCP software based on the vehicle miles traveled (VMT). We obtain the daily VMT for the year 2000 from Philip Nyberg, Transportation Planner at the Central Massachusetts Regional Planning Commission (CMRPC) and from Bob Frey at the Massachusetts Highway Department (see Appendix B, Table 19). We first contact Vijay Mahal, Manager of Transportation Systems Analysis at the Boston Metropolitan Planning Organization (MPO), who suggests we contact Bob Frey because Worcester is not in the jurisdiction of the MPO.

The CMRPC derives their VMT estimate for Worcester from the Travel Demand Forecast (TDF) Model. Nyberg tells us that this model takes two main pieces of information into account: the length of each roadway link and the number of vehicles passing over those links each day. The latter is estimated from a trip generation algorithm that uses households and their trip-making characteristics as its basis. Using the locations of households and employment, the model estimates the number of trips that are likely to be made for various trip purposes by location, and then assigns those trips to the road network based on a simple probability scheme of the most likely route. Allowances are made for road capacity and congestion, and only roads that carry circulating traffic are included in the model network; local streets are not included specifically in the model but are represented by special faux-road links by which the traffic mathematically enters or exits the network.

Mass Highway uses a different model to project VMT. We averaged the two VMT numbers together to obtain one daily VMT for the City of Worcester.

CMRPC also makes a forecast of the daily VMT for 2010. The 2010 model is different from the 2000 model in that any 2010 anticipated changes to the road network are added to the 2000 network and the number of households and jobs, by location, is projected into the future to update the trip-generation calculation. We use this projected VMT for 2010 to forecast emissions in 2010.

The amount of gasoline used by the municipality is estimated from the city's expenditures. Bernie Schofield, City Buyer, supplies us with the total dollars spent on gasoline from October 2002 to October 2003 by the following departments: Police Department, DPW, Holden Reservoir, Hope Cemetery, Green Hill, Airport, and the Fire Department. Hope Cemetery and Green Hill refer to the Parks and Recreation Department, while Holden reservoir refers to DPW. He also supplies us with the pricing contract and the daily gasoline prices from the Boston Journal of Commerce (JOC) for 2002 and 2003 (see Appendix B, Tables 22 and 23 for JOC prices). The price paid by the municipality for gasoline is based on the JOC prices.

There are three types of gasoline available – unleaded regular, unleaded mid-grade, and unleaded premium – and each costs a different amount. The contract states that the price per gallon also depends upon the amount of gas being delivered; if it is less than a tanker load then $.0475 is added per gallon, if it is a full tanker load then $.0444 is added per gallon. We averaged the JOC prices/gallon for each gas type for October 2002 to October 2003. We then added the amounts as determined from the contract to these averaged prices, therefore leaving us with average prices for regular, mid-grade, and premium delivered in less than a tanker and regular, mid-grade, and premium delivered in a full tanker load. We averaged the three fuel-grade prices for a full tanker delivery, as well as for a less than tanker delivery, using equal weighting to get one average price/gal for each. Since the full tanker and less than tanker prices are so similar, when fractions of a cent are not considered, the averaged prices are equal. The low value was found for regular gas delivered by a full tanker, while the high value was found for premium gas delivered by less than a tanker load. Dividing the averaged price/gal into the amount spent per department gives us an approximate number of gasoline gallons purchased and used for each department (see Appendix B, Table 21).

Diesel

The amount of diesel fuel used by the city at large is also determined by the CCP software based on the vehicle miles traveled as estimated by the CMRPC and Mass Highway.

The amount of diesel fuel used by the municipality is obtained the same way as the heating oil. Bernie Schofield, City Buyer, collected the data from the vendor, Peterson Oil. The data is for the time period from October 2002 to October 2003 (see Appendix B, Table 20 for Municipal Diesel use).

Solid Waste: Incineration and Recycling

Total tonnage of solid waste coming from the City of Worcester in 2003 is reported by Wheelabrator Waste Incineration Facility in Millbury, MA – where all of Worcester's waste is sent (see Appendix B, Table 26). We collected yearly tonnage of waste and recyclables from Bob Fiore at DPW for the Residential and part of

the Municipal sectors for the years 1994-2003 (see Appendix B, Table 24). Waste generated by schools is not included in this data. Fiore also supplied us with the approximate amount of waste composted in 2003, which is an important number because it represents the amount of waste diverted from the incinerator (see Appendix B, Table 25).

Census Data

We obtained US Census data for the City of Worcester – years 1980, 1990, and 2000 – as well as population data for years 1940-2002 from Paul Lacava, Assistant City Manager. From this data we derive growth rates for population, households, and employees (see Appendix B, Table 28).

(Footnotes)

[1] 1 therm = 100,000 British thermal units (Btu)

Additional Data for Inventory

After the publication of the above referenced document, "Creating A GHG Emissions Inventory for Worcester", published April 2004, further data were collected and input into the baseline inventory reported in this document. Sewage Treatment Plant (UBWPAD) data were collected from Tom Walsh. Data included electricity, natural gas, heating oil, diesel fuel, and unleaded gasoline consumed in FY2006. Electricity cosumed by the Holden Reservoir water treatment facility was collected from Bob Hoyt, Director of Water Treatment, for the time period 1997 through 2005. Composting data was collected from Bob Fiore of DPW for 2005. For those school buses serving WPS, emissions data was collected from Durham School Bus for the 2005-2006 school year. Waste in place data for the Greenwood Street Landfill was collected from Bob Fiore, DPW.

Emissions Inventory Software Inputs

Community Analysis Module

Residential

(Fuel)

Electricity:	403,821,151 kWh (2002)
Natural Gas:	39,986,711 therms (2002)
Light Fuel Oil:	12,308,175 gallons (2000)

(Indicators)

# of Households:	67,742 households (2002)

(Forecast Builder)

Electricity Growth Rate:	2.4%/yr (1997-2002)
Natural Gas Growth Rate:	1.0%/yr (1990-2000)
Light Fuel Oil Growth Rate:	-1.3%/yr (1990-2000)

Households Growth Rate: .49%/yr (1990-2000)

Commercial

Commercial / Industrial

(Fuel)

Electricity: 1,000,463,924 kWh (2002)
Natural Gas: 66,032,771 therms (2002)
Light Fuel Oil: 2,282,106 gallons (2002)

(Indicators)

# of Employees: 73,365 employees (2000 and 2004)

Municipal

(Fuel)

Electricity: 79,790,992 kWh (~2002, UBWPAD data 2006)
Natural Gas: 9,083,990 therms (2002, UBWPAD data 2006)
Light Fuel Oil: 788,614 gallons (Oct 2002 - Oct 2003, UBWPAD data 2006)
Diesel: 246 thousand gallons (Oct 2002 – Oct 2003)
ULSD: 1 million vehicle miles (2005) (Transit Bus)
Gasoline: 1,154,780.5 gallons (Oct 2002 – Oct 2003)

(Indicators)

# of Employees: 4,110 municipal employees (2004)

(Forecast Builder)

Electricity Growth Rate: 1.3%/yr (19997-2002)
Employee Growth Rate: 2.1%/yr (1990-2000)

Transportation

(Emissions Source)

Vehicle-miles Traveled: 968.4 million vehicle-miles traveled (2000)

(Emissions Source in Forecast Year (2010))

Vehicle-miles Traveled: 1,089.4 million vehicle-miles traveled (2010)

Report

2002 city population: 174,962 (2002)

Government Analysis Module

Buildings

Schools

(Fuel)

Electricity: 23,530,572 kWh (~2002)
Natural Gas: 1,638,300 therms (2002)

Other Buildings
(Fuel)

Electricity: 19,788,348 kWh (~2002)
Natural Gas: 473,900 therms (2002)

All Buildings
(Fuel)

Light Fuel Oil: 768,611 gallons (Oct 2002 - Oct 2003)

Vehicle Fleet

(Fuel)

Diesel: 246 thousand gallons (Oct 2002 – Oct 2003)

Department of Public Works
(Fuel)

Gasoline: 268.856 thousand gallons (Oct 2002 – Oct 2003) (Light Truck/SUV/Pickup)

Holden Reservoir
(Fuel)

Gasoline: 14.971 thousand gallons (Oct 2002 – Oct 2003) (auto full size)

Hope Cemetery - Parks Department
(Fuel)

Gasoline: 6.198 thousand gallons (Oct 2002 – Oct 2003) (auto full size)

Green Hill - Parks Department
(Fuel)

Gasoline: 4.829 thousand gallons (Oct 2002 – Oct 2003) (auto full size)

Police Department
(Fuel)

Gasoline: 247.645 thousand gallons (Oct 2002 – Oct 2003) (auto full size)

Fire Department
(Fuel)

Gasoline: 24.205 thousand gallons (Oct 2002 – Oct 2003) (Light Truck/SUV/Pickup)

Airport
(Fuel)

Gasoline: 10.684 thousand gallons (Oct 2002 – Oct 2003) (Light Truck/SUV/Pickup)

UBWPAD
(Fuel)

Gasoline: 4.748 thousand gallons (FY2006) (Light Truck/SUV/Pickup)
Diesel: 5.189 thousand gallons (FY2006) (Heavy Truck)

School Buses
(Fuel)
ULSD: 1 million vehicle miles (2005) (Transit Bus)

Streetlights

Streetlights
(Fuel)
Electricity: 10,807,759 kWh (2002)

Traffic Lights / Recreational Lights
(Fuel)
Electricity: 6,672,713 kWh (~2002)

Water/Sewage

UBWPAD
(Fuel)
Electricity: 15,914,800 kWh (2002)
Natural Gas: 6,971,790 therms (2002)
Light Fuel Oil: 20,003 gallons (2000)

Water Treatment
(Fuel)
Electricity: 3,076,800 kWh (2002)

Waste

(Emissions Source)
Waste Incinerated: 37,000 tons (2003)

(Emissions Source)
Compost: 20,000 tons (2005)

(Forecast Builder)
Waste Growth Rate: 2.3%/yr

Waste In Place

Landfill Name: Greenwood Street Landfill
Waste in Place: 2,150,000 tons
Opening Year: 1973
Closing Year: 1985
Methane Recovery Factor: 0%

CACPS Output Emissions Data for Inventory Charts

WORCESTER'S EMISSIONS by SECTOR
Figure 8

	eCO2 (tons)
Commercial / Industrial	813106
Municipal	106298
Transportation	652223
Waste	95240
Residential	542318
Electricity	*152871*
Light Fuel Oil	*142400*
Natural Gas	*247047*
TOTAL	**2,209,185**

RESIDENTIAL EMISSIONS BY SOURCE
Figure 9

	eCO2 (tons)	Energy (MWh)	Efficiency
Electricity	28	19	.68
Light Fuel Oil	26	24	.92
Natural Gas	46	57	1.24

WORCESTER'S EMISSIONS by SOURCE
Figure 11

	eCO2 (tons)
Diesel	110315
Electricity	561815
Gasoline	541908
Light Fuel Oil	177927
Natural Gas	711135
ULSD	1936
Waste	95240
TOTAL	**2,209,185**

MUNICIPAL EMISSIONS BY SECTOR
Figure 13

	eCO2 (tons)
Buildings	88835
Streetlights	4091
Traffic and Rec Lights	2526
Vehicles	10846
Waste	95240
TOTAL	**201,538**

ELECTRICITY CONSUMED BY MUNICIPAL BUILDINGS

Figure 14

	eCO2 (tons)
Schools	8908
Sewage	6025
Water	1165
Airport	961
Other	6530

RESIDENTIAL AND SOME MUNICIPAL WASTE

Figures 16 and 17

	Recycling	Incinerator	Total Waste	Recycling as a % of Waste
1994	13,103	22,810	35,913	36.49%
1995	12,729	24,076	36,805	34.58%
1996	12,374	24,362	36,736	33.68%
1997	9,887	24,474	34,361	28.77%
1998	9,917	25,650	35,567	27.88%
1999	10,145	26,343	36,488	27.80%
2000	10,845	27,875	38,720	28.01%
2001	9,575	29,084	38,659	24.77%
2002	9,529	28,596	38,125	24.99%
2003	9,965	27,868	37,833	26.34%
2004	9,992	27,427	37,419	26.70%
2005	9,735	26,864	36,599	26.60%

F**igure 15**

	Tons (2005)
Recycling	9,735
Incinerator	26,864
Compost	20000

ANNUAL ELECTRICITY CONSUMPTION BY HOUSEHOLDS

Figure 18

Year	kWh
1997	5561
1998	5608
1999	6021
2000	6062
2001	6276
2002	6467

Appendix F: Sources of Funding

GRANTS

Title: **Climate Protection Grant**
Funder: MassDEP and EOEA
Award: $100,000 available. The Idling Reduction Toolkit value ranges from $500 to $2,000, depending on the population of the municipality. The retrofit equipment is valued at approximately $1,200 per vehicle.
Use: Anti-idling campaign, diesel retrofits, or anything else that would help reduce greenhouse gas emissions. Must be a CCP community.
Due Date: March 6, 2006

Title: **Municipal Waste Reduction & Climate Protection Grants**
Funder: Mass DEP
Award: $7,500 to $25,000 (for climate protection grants)
Use: Many types of grants available
Due Date: September 15, 2006
Summary: This application provides municipalities, schools and regional groups with the means to qualify for waste reduction and water conservation equipment, consumer education materials, Pay-as-You-Throw grant assistance, home composting equipment, rain barrel and water conservation home epuipment, school chemical management/clean out, idling reduction, diesel retrofit technology, and technical assistance (in Climate Protection or Waste Reduction) from MassDEP.

NEW IN FY07 - Climate Protection Grants To be eligible for a Climate Protection Grant, a city or town must be registered or in the process of registering to become a Cities for Climate Protection partner, as part of ICLEI. More information can be found at www.iclei.org or by contacting Kim Lundgren at 617-635-3853. Climate Protection grants will support activities identified in a community's Local Action plan or other climate protection planning document.

Further Info: **http://www.mass.gov/dep/recycle/mwrgin07.pdf**

Title: **Environmental Stewardship Grant**
Funder: Entergy
Award: Up to $250K expected to be available, award range generally $5K to $25K
Use: Energy Efficiency and Renewable Energy
Due Date: March 10,2006
Further Info: Online application
http://www.entergy.com/our_community/environmental_grants.aspx

Title: **Healthy Communities Grant Program**
Funder: EPA New England
Award: Grants may be requested for amounts ranging from $5,000 - $30,000 for one to two year project periods starting October 1, 2006. Although the project period can last up to two years, the total amount requested for federal resources cannot exceed $30,000.
Use: Multiple
Due Date: One-Page Project Summaries due on 04/05/06
Full Proposals due on 05/26/06
Summary: The Healthy Communities Grant Program is EPA New England's main competitive grant program to work directly with communities to reduce environmental risks, protect and improve human health and improve the quality of life. The Healthy Communities Grant Program will achieve this through identifying and funding projects that:

- Target resources to benefit communities at risk [environmental justice areas of potential concern, places with high risk from toxic air pollution, urban areas and sensitive populations (e.g. children, elderly, others at increased risk)].
- Assess, understand, and reduce environmental and human health risks.
- Increase collaboration through community-based projects.
- Build institutional and community capacity to understand and solve environmental and human health problems.
- Achieve measurable environmental and human health benefits.

Title: Pew Charitable Trusts Grant
Funder: The Pew Charitable Trusts
Award: Varies; median $300,000
Use: Applicable to 501(c)3; many uses under sections of Advancing Policy Solutions, Informing the Public, and Supporting Civic Life. Environment is a part of Advancing Policy Solutions and (see desc. of environment below). The PEW also has a specific focus on Global Warming.
Due Date: Annual; first step is to submit 1 page proposal
Summary: The environmental work of the Trusts employs science, law, public education and advocacy, aimed at halting and ultimately reversing the trends that are threatening nature. They work collaboratively with a host of colleagues and institutions representing a broad spectrum of American life.
Further Info: http://www.pewtrusts.com/grants/index.cfm

VARIOUS CLEAN ENERGY GRANTS
MTC - Renewable Energy Trust

http://www.masstech.org/RenewableEnergy/solicitations/index.htm

CLEAN ENERGY PROGRAM

http://www.masstech.org/renewableenergy/cleanenergy.htm
This program seeks to increase both the supply of and demand for renewable energy. On the

supply side, it supports both utility-scale and community-scale energy projects that harness the wind, sun, and bioenergy. On the demand side, it educates citizens, teachers, and students, and advances the green electricity market by giving consumers objective information and attractive choices.

Education and Outreach:

The **K-12 Education Initiative** educates the next generation of consumers and voters by incorporating renewable energy into the curriculums of schools throughout Massachusetts.

The **Public Awareness Initiative** encompasses a wide range of activities, including the Clean Energy Tour, that seek to increase the profile of renewable energy with the public. Grants are available for public education.

Consumer Clean Energy Purchasing:

The **Clean Energy Choice** program makes it more desirable, more beneficial, and safer for consumers to make voluntary green electricity purchases. The program enables some payments to be tax deductible for federal income taxes and provides matching grants that benefit consumers' communities and low-income residents.

Title:	**Clean Energy Choice®**
Funder:	MTC
Award:	Dependent on Residents, Non-competitive
Use:	To Support Clean, Renewable Energy
Due Date:	NA
Further Info:	www.cleanenergychoice.org

Title:	**Clean Energy Choice – Low Income**
Funder:	MTC
Award:	Varies (last round $350,000 total)
Use:	To support clean energy in low-income areas in MA
Due Date:	Varies
Summary:	This Solicitation seeks to fund projects with the greatest likelihood of providing meaningful benefits to low-income residents. Proposals are limited to a focus on non-residential buildings (i.e. under this solicitation MTC will fund EE improvements and RE installations on buildings such as community centers, senior centers, food banks, etc.) where significant benefits to low-income residents are provided. MTC recognizes that in most cases it makes economic sense to invest in energy efficiency measures prior to installing renewable energy electricity generation equipment. Therefore this Solicitation allows that proposed implementation project budgets may be structured so that up to 30% of funds will go to the implementation of EE measures and the remainder of the funds will go to the implementation of RE installations. Energy efficiency efforts need to be ones that would not have happened without RET funds.
Further Info:	http://www.masstech.org/Grants_and_Awards/CEC/CEC_rfp.html

Clean Energy Development:
The **Predevelopment Financing Initiative** provides financial assistance to developers as they undertake the high-risk, early-stage activities related to the development of new renewable energy facilities.

The **Community Wind Collaborative** helps cities and towns across the Commonwealth develop small-scale, community-owned wind projects. The Trust is currently working with more than 40 communities.

Planning and Policy:
Siting & Planning activities provide communities and regions within the Commonwealth with tools and resources they need to make sound renewable energy decisions. MTC encourages open constructive dialogue among constituencies that have an interest in the outcome of proposed projects.

GREEN BUILDINGS AND INFRASTRUCTURE

http://www.masstech.org/renewableenergy/green_buildings.htm
This program promotes the use of renewable energy technologies in all types of buildings and other distributed applications. It has provided funding to a wide range of green building projects, solar installations, and infrastructure improvements. It encourages efforts that help the marketplace to value and support green buildings and renewable energy installations.

Title:	**Small Renewables**
Award:	up to $50,000
Use:	small renewable generation systems (up to 10 kW in size)
Due Date:	Rolling
Further Info:	http://www.masstech.org/renewableenergy/small_renewables.htm

Title:	**Large Renewables**
Award:	up to $40,000 for feasibility, $75,000 for design, $500,000 for const.
Use:	large renewable energy generation systems (more than 10 kW in size) Organizations can apply for feasibility or design and construction grants.
Due Date:	February 2007
Further Info:	http://www.masstech.org/renewableenergy/large_renewables.htm

Title:	**Green Affordable Housing Initiative: Sun Power for Energy Star Homes**
Award:	up to $50,000
Use:	PV under 3.5KW on homes
Summary:	Installation incentives for affordable ENERGY STAR Qualified New Homes, through a $1.5 million partnership with the investor-owned utility Joint Management Committee (JMC), through the Sun Power for ENERGY STAR® Homes program.
Further Info:	http://www.masstech.org/renewableenergy/green_buildings/afford/sun_power.html

Title: **Green Affordable Housing Initiative: Massachusetts Green Communities**

Award: up to $30,000 for feasibility studies, $50,000 for renewable energy system design, $500,000 for renewable energy system installation

Summary: Feasibility, Design and Construction incentives for larger multifamily affordable rental housing developments that meet ENERGY STAR standards, and are pursuing loan funding through MassHousing, or are receiving Commonwealth Affordable Housing Trust Funds, as part of the Massachusetts Green Communities™ partnership.

Further Info: http://www.masstech.org/renewableenergy/green_buildings/afford/green_communitites.html

Previous programs for Green Buildings and Infrastructure include the **Green Schools Initiative**, the **Green Buildings Initiative**, the **Fuel Cell Initiative**, and the **Solar-to-Market Initiative**.

INDUSTRY INVESTMENT AND DEVELOPMENT (II&D) PROGRAM

http://www.masstech.org/renewableenergy/industry_support.htm

This program accelerates job growth, economic development, and technological innovation in the Massachusetts renewable energy industry. It makes direct investments to catalyze new product commercialization, builds networks and provides services that better enable companies to access capital and other vital resources, and strive to lower barriers to success for entrepreneurs in the state.

No current programs. Previous programs include Emerging Technology Demonstration (ETD) Program.

POLICY UNIT

http://www.masstech.org/renewableenergy/public_policy.htm

The policy unit of the Renewable Energy Trust collaborates with interested stakeholders to address market and regulatory barriers that block the increased availability, use, and affordability of renewable energy.

No current programs.

GRANT SEARCH KEYWORDS

Climate Change
Global Warming
Greenhouse Gas Emissions
CO2
Energy Use
Emissions
environmental
sustainability
Renewable
Cities for Climate Protection
Biodiesel
Hybrid
Solar
Wind
Hydro
Efficiency
Green

OTHER GRANT FUNDING SOURCES

http://foundationcenter.org/
http://www.eere.energy.gov/state_energy_program/projects_state.cfm
http://www.mass.gov/doer/
http://www.grants.gov/
http://www.epa.gov/ogd/competition/open_awards.htm
http://www.mass.gov/dep/recycle/recawgr.htm

FUNDING RECEIVED BY NEWTON, MA

Project	Funding Source	Amount
Million Solar Roofs partnership	US Dept. of Energy (USDOE)	$30,000
NSHS green design and solar energy	Mass. Renewable Energy Trust (MRET)	$625,000
Sunergy program implementation	MRET (MTC)	$45,000
Sunergy coordinator staff position	USDOE	$40,000
NNHS green design feasibility study	MRET (MTC)	$20,000
Utility rebates for energy efficient retrofits	NSTAR Electric & Keyspan Energy	Over $400,000

UTILITY FUNDING PROGRAMS

NATIONAL GRID

www.nationalgridus.com/masselectric/business/energyeff/energyeff.asp

National Grid's energy efficiency programs can help improve the energy efficiency at an existing or new facility by lowering operation and maintenance costs.

LARGE BUSINESS PROGRAMS

You can benefit from a collection of energy efficiency services whether you have an existing facility that needs improvement or you're building a new facility.

NEW CONSTRUCTION INCENTIVES
(Design 2000plus)

Design 2000plus offers technical assistance and financial incentives to large commercial and industrial customers who are building new facilities, adding capacity for manufacturing, replacing failed equipment or undergoing major renovations.

We offer financial incentives through the programs listed below to help defray costs of improvements. Through our Custom Projects program, incentives of up to 75% of the additional cost for efficiency upgrades are available. Even higher incentives and a wide variety of energy efficient opportunities are available through our other programs. For more information, contact your Business Services Office.

- Lighting & Controls
- HVAC Systems
- Motors
- Custom Projects
- Compressed Air
- Variable Speed Drives

EXISTING FACILITY INCENTIVES
(Energy Initiative)

We offer technical assistance and incentives to help you purchase and install the energy efficient equipment and systems for your facility. Through our Custom Project program, incentives of up to 45% of the project cost are available. Review the other programs listed below for more energy efficient opportunities.

- Lighting & Controls
- HVAC Systems
- Motors
- Custom Projects
- Compressed Air
- Variable Speed Drives

SERVICES

Find out more about the services we offer to help make it easy for you to install energy efficient technologies.

• Technical Assistance—Engineering and support services available to assist you in getting projects underway.
• Turnkey Services—Authorized, qualified vendors to help you identify and install your energy efficient opportunities.
• Commissioning—A quality control process to ensure that your heating, cooling, and other mechanical systems work efficiently together to save energy and reduce your operating costs.
• Lamp and Ballast Recycling—Provides recycling for older lighting lamp and ballast containing toxic PCBs subject to regulations.
• Buyers Alliance—Lighting equipment discounts on quality lighting energy efficient products.
• Financing—Designed to help assist you with funding for qualifying energy efficiency projects without disrupting your budget.

SMALL BUSINESS PROGRAM

For business customers with an average demand use of 200 kilowatts or less (or 40,300 kilowatt-hours or less) per month, we can help you reduce your company's energy costs by installing energy efficient equipment.

- We can provide a free energy audit and report of recommended energy efficiency improvements
- We pay 80% of the cost of the installation of energy efficient equipment and you can finance the remaining 20% interest free for up to 24 months.
- Cost-cutting, energy efficient equipment available through this program includes:
    - Lighting Upgrades
    - Energy Efficient Time Clocks
    - Photo Cells For Outdoor Lighting
    - Occupancy Sensors
    - Programmable Thermostats
    - Walk-in Cooler Measures

Register for Free Energy Audit

Registration Form —If you are interested in reducing your business' energy costs, schedule a free, no obligation energy audit by completing this online form. You can also call us at 1.800.332.3333.

Additional Information

- Small business brochure (pdf)

TRAINING & EDUCATION

Learn more about energy efficient technologies and how you can apply them to your business. Explore additional resources for managing your energy costs.

BUILDING OPERATOR CERTIFICATION

This program is a competency-based training and verification program for building operators designed to improve the energy efficiency of commercial and industrial

buildings. Building operators can earn certification by attending training sessions and completing project assignments in their facilities. The training and certification initiative is designed to replicate a program developed in the Northwest United States by the Northwest Energy Efficiency Council. The initiative is sponsored by several gas and electric utilities in the Northeast region and administered by the Northeast Energy Efficiency Partnerships.

- Training seminars on operating your facility efficiently.
- Level 1 Certification Program - participants must attend eight classes (seven one-day and one two-day), and complete all exams and job related application projects.
- Level 2 Certification Program - participants are certified and must attend four core classes (three one-day and one two-day), and two elective classes, complete exams and assigned projects.
- Complete details available at the Northeast Energy Efficiency Partnerships: Building Operator Certification website*.

COMPRESSED AIR CHALLENGE

Nationally recognized programs and seminars developed by a national collaborative of government and private industry organizations committed to promoting compressed air system efficiency.

- Fundamentals of Compressed Air Systems
- Advanced Management of Compressed Air Systems (Level II)

ENERGY STAR®

As an ENERGY STAR partner, we promote continuous energy performance improvement in commercial and industrial facilities. We work together with ENERGY STAR to bring your organization financial and technical assistance, tools, and information to help you better manage energy, which can reduce operating costs and pollution.

We are partnering with ENERGY STAR in the new construction and existing facility markets. Some programs in which you can participate include:

- New Construction Incentives (for large businesses)
- Existing Facility Incentives (for large businesses)
- Our Small Business Program

ENERGY STAR recognizes superior performance in buildings and organizations, helps businesses and public organizations save money, and helps protect the environment through reduced energy use. As the government-backed, trusted symbol for energy efficiency, the ENERGY STAR label also identifies highly efficient products and designates superior energy performance in homes. For more information about ENERGY STAR, visit www.energystar.gov*.

ADDITIONAL RESOURCES

Use these resources and information to help manage your energy costs.

ESource Information: Managing Energy Costs

- Colleges and Universities (pdf)
- Grocery Stores (pdf)
- Hospitals (pdf)
- Hotels (pdf)
- Motels (pdf)
- Office Buildings (pdf)
- Restaurants (pdf)
- Retail Buildings (pdf)
- Schools (pdf)

Additional Information

- The Alliance to Save Energy website*
- The American Council for an Energy-Efficient Economy website*
- The Consortium for Energy Efficiency website*
- The Energy Center of Wisconsin website*
- U.S. Department of Energy: The Energy Efficiency and Renewable Energy Network website*
- EnergyStar website*
- New Building Institute website*
- The Northeast Energy Efficiency Council website*
- The Northeast Energy Efficiency Partners website*
- The Northwest Energy Efficiency Alliance website*

NSTAR Gas

Our menu of recently enhanced energy-efficiency programs offer our customers the opportunity to reduce energy consumption and save money, while maintaining or improving working conditions. www.nstaronline.com/residential/energy_efficiency/gas_programs/

PROGRAMS

(Please note: Customers on rate G-53 or T-1 are not eligible for participation in these energy efficiency programs.)

CUSTOM PROGRAM

Save energy and money with high-efficiency gas technologies. NSTAR's Custom Program will pay up to 50% of the incremental cost between standard and high-efficiency equipment. Some of the covered technologies include:

- Desiccant dehumidification
- Condensing boilers and furnaces greater than 300,000 BTU
- Direct contact water heaters
- Combustion controls
- Double-effect absorption chillers
- Waste heat recovery

For more information, please contact NSTAR at 781-441-8592, 1-800-592-200 or email C_and_I_Energy_Efficiency@nstaronline.com.

SMALL BUSINESS HIGH-EFFICIENCY HEATING REBATES

Need new heating equipment? Purchase high efficiency-rated heating equipment (300,000 BTU max) for your business and increase your benefits of saving energy with a rebate check for the following:

- $500 for forced hot water boilers greater than or equal to 85% AFUE (Annual Fuel Utilization Efficiency).
- $200 for steam boilers greater than or equal to 82% AFUE.
- $400 for warm air furnaces with an AFUE rating of at least 92% and equipped with an electronic commutated motor (ECM) or equivalent advanced furnace fan system.
- $150 for furnaces greater than or equal to 90% AFUE.

SMALL BUSINESS HIGH-EFFICIENCY WATER HEATING REBATES

Need new gas water heating equipment? NSTAR Gas offers a $300 rebate toward the purchase of high-efficiency indirect-fired gas water heaters.

INFRARED HEATING EQUIPMENT REBATES

Infrared gas heating equipment is the perfect choice for warehouses, loading docks, garages and other types of facilities where maintaining temperatures is difficult. With this program, get a $500 rebate for each legally installed low-intensity infrared heating unit.

HIGH EFFICIENCY FRYER REBATES

NSTAR Gas now offers rebates of $300 to $500 when you purchase an eligible high efficiency fryer, depending on the model you choose. High efficiency fryers use 15 to 50 percent less energy than typical gas-fired models.

HOW TO APPLY

1. To receive an application form for any of the above four programs, call 800-232-0672 or visit gasnetworks.com to print a rebate application.
2. Mail the completed application along with a copy of the invoice for the equipment purchase and installation.

Upon verification of specifications noted above, a rebate check will be mailed to you. Rebates are available on a first-come, first-served basis. Program subject to change without notice.

ENERGY SERVICE COMPANIES

Energy Services Performance Contracts*

Energy services performance contracting is a common way toimplement energ;y efficiency irnprovements and frequently coversfinancing Ior the needed equipment. An energy services performancecontract is an agreement between a government and a private energy services provider, or ESP. The ESP identifies and evaluatesenergy-saving opportunities and recommencls improvementsthat can be paid for through savings. The ESP usually guarantees that savings will meet or exceed annual payments to cover all proiect costs. If the savings do not materialize, the ESP pays the dithrence. The contract clearly identifies the procedures by which these savings are to be measured and verified.

A common concern is the ESP's ability to meet future obligations should the energy savings not occur. Investment-grade ESPs will support the transactions with their strong balance sheets. Some transactions include the creation of a reserve fund to cover potential shortfalls. Other security enhancements may take the form of performance bonds or letters of credit.

Performance contracts come in all shapes and sizes. They can be tailored to provide comprehensive solutions to energy waste, to take advantage of efficiency opportunities, and to supply needed products and services. Careful review of most performance contracts will reveal three related but independent offerings-a project development agreement (identifying what needs to be done to save the money), an energy services agreement (showing how to continue to save after the equipment has been installed), and a financing agreement.

The most popular performance contract used in the public sector is called a guaranteed savings agreement. A guaranteed savings agreement bundles equipment purchasing and performance guarantees, and it also may include financing, maintenance, and energy costs. Analyzing the performance contract by its component parts allows any organization to evaluate which activities are best handled internally and which should be outsourced. For example, ESPs usually borrow at taxable interest rates, whereas public agencies are able to issue lower cost tax-exempt obligations. Therefore, financing is usually less expensive when provided by the government.

Properly structured performance contracts can be treated as an operating expense, and the energy savings can be used to pay for equipment, engineering audits, and services, Governments can overcome the aforementioned lack of time and lack of expertise barriers by outsourcing the work to qualified, reputable energy services providers using a performance contract.

*Excerpt and tables from "Financing Energy Efficiency Projects" Neil Zobler and Katy Hatcher Government Finance Review, February 2003

FINANCE NOW OR WAIT FOR CASH?

	Option A - Fast Track Financing				Option B - Waiting for Cash			
Year	Savings	Cost	Annual Cash Flow	Cumulative Cash Flow	Savings	Cost	Annual Cash Flow	Cumulative Cash Flow
1	$200,000	($164,026)	$ 35,974	$ 35,974	$ 0	$ 0	$ 0	$ 0
2	200,000	(164,026)	35,974	71,949	200,000	(1,000,000)	(800,000)	(800,000)
3	200,000	(164,026)	35,974	107,923	200,000	0	200,000	(600,000)
4	200,000	(164,026)	35,974	143,897	200,000	0	200,000	(400,000)
5	200,000	(164,026)	35,974	179,872	200,000	0	200,000	(200,000)
6	200,000	(164,026)	35,974	215,846	200,000	0	200,000	0
7	200,000	(164,026)	35,974	251,820	200,000	0	200,000	200,000
8	200,000	0	200,000	451,820	200,000	0	200,000	400,000
9	200,000	0	200,000	651,820	200,000	0	200,000	600,000
10	200,000	0	200,000	851,820	200,000	0	200,000	800,000
11	200,000	0	200,000	1,051,820	200,000	0	200,000	1,000,000
12	200,000	0	200,000	1,251,820	200,000	0	200,000	1,200,000
	Net Present Value—Option A			$ 892,524	Net Present Value—Option B			$ 760,151

COMPARING FINANCING OPTIONS FOR ENERGY PROJECTS

	CASH	BONDS	MUNICIPAL LEASES	PERFORMANCE CONTRACTS
Interest Rates	N/A	Lowest tax-exempt rate	Lowlax-exemptrate	Can be taxable or tax-exempt
Financing Term Term	N/A	May be 20 years or more	Up to 10 years is common and up to 12-15years is possible for large projects	Typically up to 10 years, but may be as long as 15 years
Other Costs	N/A	Underwriting,legal opinion, insurance, etc.	None	May have to pay engineering costs if contract not executed
Approval Process	Internal	May have to be approved by voters via referendum	Internal approvals needed.Simple attorney letter required	RFP usually required; internal approvals needed
ApprovalTime	Current budget period	May be lengthy-process may take over a year	Generally within one week	Generally within1-2 weeks once the award is made
Funding Flexibility	N/A	Very difficult to go above the dollar ceiling	Can set up a master lease, which allows you lo draw down funds as needed	Relatively flexible. An underlying municipal lease is often used
Budget Used	Either	Capital	Operating	Operating
Greatest Benefit	Direct access if included in budget	Lowinterestrate because it is a general obligation of the public entity	Allows you to buy capital eguipment using operating dollars	Provides performance guarantees that help approval process
Greatest Hurdle	Never seems to be enough money available for projects	Very time consuming	Identifying the project to be financed	Identifying the project to be financed, selecting the energy service provider

Appendix G: NGRID's Energy Management Resources

http://www.nationalgridus.com/masselectric/business/programs/programs.asp

ENERGY PROFILER ONLINE™

Sign up to take advantage of Energy Profiler Online™, a tool that provides you with access to your facility's interval load data.

Easy Access to Your Energy Information

Energy Profiler Online™ allows you to understand how your electricity is used within your operation over time.

- Review load shapes by day, week and month
- Improve your budgeting and reporting capabilities
- Password protected—you decide who can access and review the information
- Manage your energy consumption—identify what's normal and abnormal usage
- View load profiles, usage history and information for multiple sites from previous months or years
- See the results of your energy efficiency and conservation efforts at each site
- Guide for information to shopping wisely with power suppliers
- Optional—ability to monitor your power factor
- Shift your energy usage to lower-cost time periods and move dollars to the bottom line

Annual Fee & Enrollment

Enroll for less than a dollar a day!

- $321 annually for the service at your facility
- $275 annually for each additional facility, requested at the same time

To enroll, complete the enrollment form (pdf).

For more information, please contact your Account Manager or email us.

ENHANCED METERING

Choose from Modem or Pulse service to collect your meter data for analysis.

MODEM SERVICE

We will upgrade existing metering to include a meter equipped with a modem that will collect electricity usage data every 15 minutes.

- You purchase, install, and maintain a phone line to your meter location.
- We will connect the meter to your phone line and then call the meter daily to provide your facility's interval data.
- With the appropriate software and your phone line, you can access your meter data and perform your own analysis.

Fees & Enrollment

Payment plan choices:

- A one-time fee of $270.49
- An on-going fee of $12.29 per month, per meter

To enroll, complete the enrollment form (pdf).

PULSE SERVICE

We upgrade existing metering to include a meter equipped with a pulse output for use with your own energy management system.

- You purchase, install, and maintain a pulse recorder near your meter location.
- We will connect the pulse outputs from the meter to a pulse interface device to which you can attach.
- With your pulse recorder in place, you can collect your facility's energy usage data and review via your own energy management system and/or translation software.

Fees & Enrollment

Payment plan choices:

- A one-time fee of $132.06
- An on-going fee of $6.00

To enroll, complete the enrollment form (pdf).

DEMAND RESPONSE PROGRAMS

Demand response programs focus on reducing customers demand (kW) for a few critical hours during the year. Together with ISO-New England, we offer demand response programs for customers > 200 kW with at least 100 kW of curtailable load that encourage facility managers to lower energy use during certain key conditions:

- Tight power supply
- Local distribution equipment approaching capacity limits
- When wholesale power supply prices are expected to exceed $100 per mWh

You will receive credits on your electric bill if you participate in a demand response program, In addition, lowering your peak demand through demand response may enable you to negotiate a lower price from your power supplier.

To Participate

- Contact Doug Smith

To assist you in identifying ways to participate

- Enroll in Energy Profiler Online™ to review your load profile.
- Obtain a Demand Response audit that will assist you in identifying ways to participate in ISO NE's Demand Response programs.

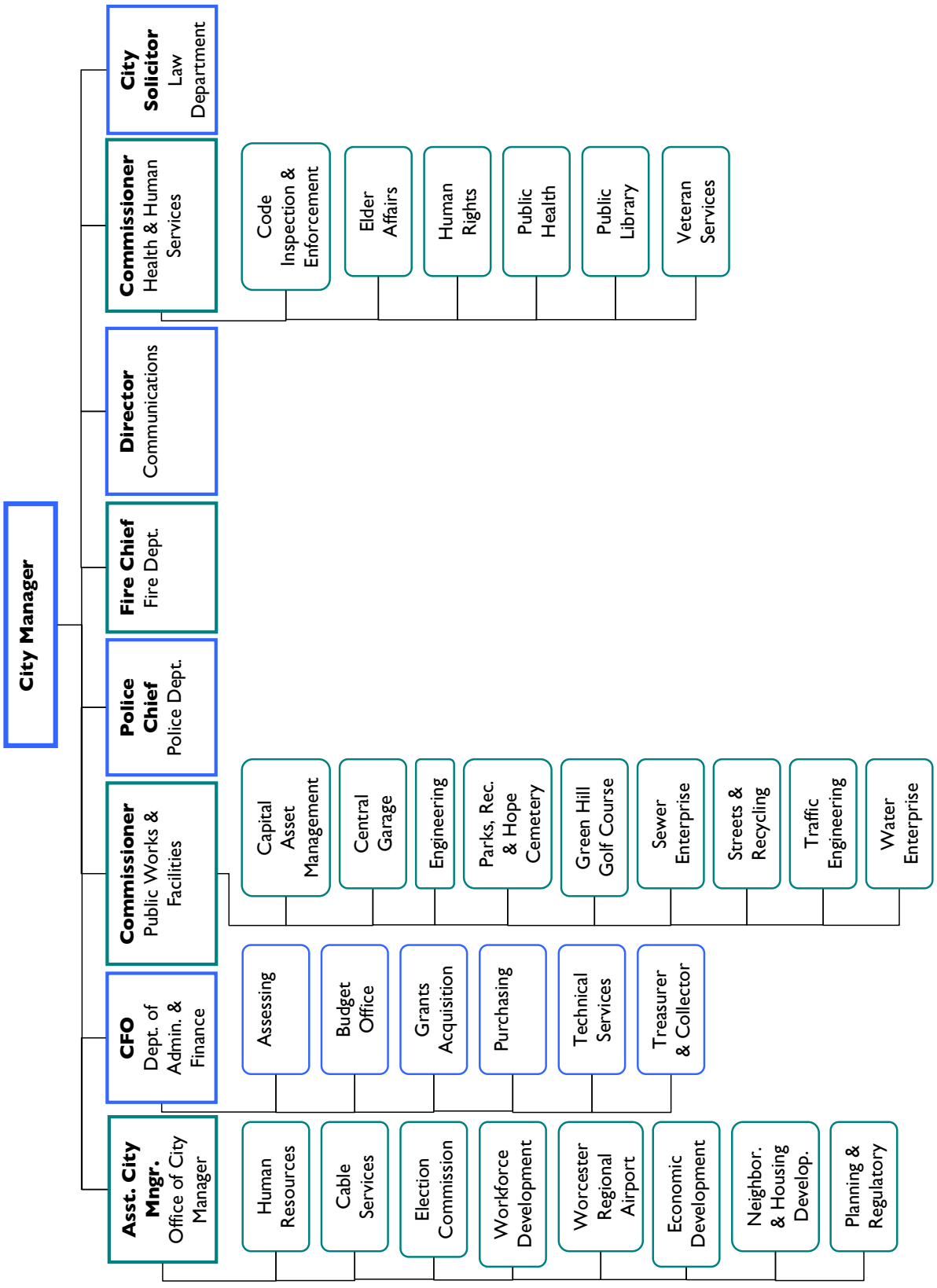
Load Response Program Agreement Forms

- Real-Time Response Program via Low Tech Option (pdf)
- Real-Time Response Program via Super Low Tech Option (pdf)

Additional Information

- Energy Profiler Online Presentation (pdf) This provides information on the Energy Profiler Online service.
- Retail Mall Demand Response - Case Study (pdf) This shows the impact on a customer's load by participating in a demand response event.
- Sample Demand Response Audit (pdf) This is an example of the load information and action plan a customer receives from a demand response audit.
- ISO-New England—Load Response Event Summary Archive This shows the most recent demand response events called by ISO-NE.
- ISO New England—Location Marginal Price Map* This shows the current real time and day ahead LMP prices by load zone.
- ISO New England—Demand Response Summit April 23, 2004* These are informative presentations on ISO-New England's Demand Response programs

Appendix H: Municipal Government Organization



Appendix I: Fuel Efficient Vehicles List

Top rated vehicles in terms on fuel efficiency. More detailed information is available.

Source: http://www.epa.gov/emissweb/

Year	Model	Displ	Cyl	Trans	Drive	Fuel	Veh Class	Air Pollution Score	City MPG	Hwy MPG	GHG Score	Smart Way Score
2006	ACURA RSX	2	(4 cyl)	Man-5	2WD	Gasoline	small car	6	27	34	8	yes
2007	AUDI A3	2	(4 cyl)	Auto-S6	2WD	Gasoline	station wagon	7	25	32	7	yes
2007	AUDI A3	2	(4 cyl)	Man-6	2WD	Gasoline	station wagon	7	23	32	7	yes
2006	AUDI A3	2	(4 cyl)	Auto-S6	2WD	Gasoline	station wagon	7	25	31	7	yes
2006	AUDI A3	2	(4 cyl)	Man-6	2WD	Gasoline	station wagon	7	23	32	7	yes
2007	AUDI A4 Avant	2	(4 cyl)	Auto-S6	4WD	Gasoline	station wagon	7	22	30	6	yes
2007	AUDI A4 Avant	2	(4 cyl)	Man-6	4WD	Gasoline	station wagon	7	22	31	6	yes
2006	AUDI A4 Avant	2	(4 cyl)	Auto-S6	4WD	Gasoline	station wagon	7	22	30	6	yes
2006	AUDI A4 Avant	2	(4 cyl)	Man-6	4WD	Gasoline	station wagon	7	22	31	6	yes
2007	CHEVROLET Aveo	1.6	(4 cyl)	Man-5	2WD	Gasoline	small car	7	27	37	8	yes
2007	CHEVROLET Aveo	1.6	(4 cyl)	Man-5	2WD	Gasoline	small car	6	27	37	8	yes
2007	CHEVROLET Aveo 5	1.6	(4 cyl)	Man-5	2WD	Gasoline	small car	7	27	37	8	yes
2007	CHEVROLET Aveo 5	1.6	(4 cyl)	Man-5	2WD	Gasoline	small car	6	27	37	8	yes
2007	CHEVROLET Colorado	2.9	(4 cyl)	Man-5	2WD	Gasoline	pickup	6	20	26	5	no
2007	CHEVROLET Colorado	2.9	(4 cyl)	Man-5	2WD	Gasoline	pickup	6	20	26	5	no
2006	CHEVROLET Colorado	2.8	(4 cyl)	Man-5	2WD	Gasoline	pickup	6	20	27	6	no
2006	CHEVROLET Colorado	2.8	(4 cyl)	Man-5	2WD	Gasoline	pickup	6	20	27	6	no
2006	CHEVROLET Express 1500	4.3	(6 cyl)	Auto-L4	2WD	Gasoline	van	1	15	19	3	no
2006	CHEVROLET Express 2500	4.3	(6 cyl)	Auto-L4	2WD	Gasoline	van	1	15	19	3	no
2007	CHEVROLET HHR	2.2	(4 cyl)	Auto-L4	2WD	Gasoline	SUV	6	23	30	6	no
2007	CHEVROLET HHR	2.4	(4 cyl)	Auto-L4	2WD	Gasoline	SUV	6	23	30	7	yes
2007	CHEVROLET HHR	2.2	(4 cyl)	Man-5	2WD	Gasoline	SUV	6	22	30	6	no
2007	CHEVROLET HHR	2.4	(4 cyl)	Man-5	2WD	Gasoline	SUV	6	22	30	6	no
2006	CHEVROLET HHR	2.2	(4 cyl)	Auto-L4	2WD	Gasoline	SUV	6	23	30	6	no
2006	CHEVROLET HHR	2.2	(4 cyl)	Man-5	2WD	Gasoline	SUV	6	23	30	6	no
2006	CHEVROLET HHR	2.4	(4 cyl)	Auto-L4	2WD	Gasoline	SUV	6	23	30	6	no
2006	CHEVROLET HHR	2.4	(4 cyl)	Man-5	2WD	Gasoline	SUV	6	22	30	6	no
2007	CHEVROLET Malibu	2.2	(4 cyl)	Auto-L4	2WD	Gasoline	midsize car	6	24	34	7	yes
2006	CHEVROLET Malibu	2.2	(4 cyl)	Auto-L4	2WD	Gasoline	midsize car	6	24	32	7	yes
2007	CHEVROLET Optra Wagon	2	(4 cyl)	Man-5	2WD	Gasoline	station wagon	7	22	30	6	yes
2007	CHEVROLET Optra Wagon	2	(4 cyl)	Man-5	2WD	Gasoline	station wagon	6	22	30	6	no
2007	CHEVROLET Van 1500	4.3	(6 cyl)	Auto-L4	2WD	Gasoline	van	6	15	20	3	no
2007	CHEVROLET Van 1500	5.3	(8 cyl)	Auto-L4	2WD	Gasoline	van	6	15	20	3	no
2006	CHEVROLET Van 1500	5.3	(8 cyl)	Auto-L4	2WD	Gasoline	van	3	15	20	3	no
2006	CHEVROLET Van 1500	4.3	(6 cyl)	Auto-L4	2WD	Gasoline	van	1	15	20	3	no
2007	CHEVROLET Van 2500	4.3	(6 cyl)	Auto-L4	2WD	Gasoline	van	6	15	20	3	no
2007	CHEVROLET Van 2500	5.3	(8 cyl)	Auto-L4	2WD	Gasoline	van	6	15	20	3	no
2006	CHEVROLET Van 2500	5.3	(8 cyl)	Auto-L4	2WD	Gasoline	van	3	15	20	3	no
2006	CHEVROLET Van 2500	4.3	(6 cyl)	Auto-L4	2WD	Gasoline	van	1	15	20	3	no

Year	Model	Displ	Cyl	Trans	Drive	Fuel	Veh Class	Air Pollution Score	City MPG	Hwy MPG	GHG Score	Smart Way Score
2006	CHRYSLER PT Cruiser	2.4	(4 cyl)	Man-5	2WD	Gasoline	SUV	6	22	29	6	no
2006	CHRYSLER PT Cruiser Convertible	2.4	(4 cyl)	Man-5	2WD	Gasoline	SUV	6	22	29	6	no
2006	FORD E150	4.6	(8 cyl)	Auto-L4	2WD	Gasoline	van	1	15	19	2	no
2007	FORD Escape	2.3	(4 cyl)	Man-5	2WD	Gasoline	SUV	7	24	29	7	yes
2007	FORD Escape	2.3	(4 cyl)	Auto-L4	2WD	Gasoline	SUV	6	23	26	6	no
2007	FORD Escape	2.3	(4 cyl)	Man-5	4WD	Gasoline	SUV	7	22	27	6	yes
2006	FORD Escape	2.3	(4 cyl)	Man-5	2WD	Gasoline	SUV	7	24	29	7	yes
2006	FORD Escape	2.3	(4 cyl)	Man-5	4WD	Gasoline	SUV	7	22	26	6	yes
2006	FORD Escape	2.3	(4 cyl)	Auto-L4	2WD	Gasoline	SUV	6	22	26	6	no
2007	FORD Escape Hybrid	2.3	(4 cyl)	Auto-AV	2WD	Gasoline	SUV	9.5	36	31	8	yes
2007	FORD Escape Hybrid	2.3	(4 cyl)	Auto-AV	4WD	Gasoline	SUV	9.5	32	29	8	yes
2006	FORD Escape Hybrid	2.3	(4 cyl)	Auto-AV	2WD	Gasoline	SUV	9.5	36	31	8	yes
2006	FORD Escape Hybrid	2.3	(4 cyl)	Auto-AV	4WD	Gasoline	SUV	9.5	33	29	8	yes
2007	FORD Five Hundred	3	(6 cyl)	Auto-L6	2WD	Gasoline	large car	6	21	29	6	no
2007	FORD Focus	2	(4 cyl)	Auto-L4	2WD	Gasoline	small car	9.5	27	34	7	yes
2007	FORD Focus	2	(4 cyl)	Man-5	2WD	Gasoline	small car	9.5	27	37	8	yes
2007	FORD Focus	2	(4 cyl)	Auto-L4	2WD	Gasoline	small car	7	27	34	7	yes
2007	FORD Focus	2	(4 cyl)	Man-5	2WD	Gasoline	small car	7	27	37	8	yes
2007	FORD Focus Station Wagon	2	(4 cyl)	Auto-L4	2WD	Gasoline	station wagon	9.5	27	34	7	yes
2007	FORD Focus Station Wagon	2	(4 cyl)	Man-5	2WD	Gasoline	station wagon	9.5	27	37	8	yes
2007	FORD Focus Station Wagon	2	(4 cyl)	Auto-L4	2WD	Gasoline	station wagon	7	27	34	7	yes
2007	FORD Focus Station Wagon	2	(4 cyl)	Man-5	2WD	Gasoline	station wagon	7	27	37	8	yes
2006	FORD Focus Station Wagon	2	(4 cyl)	Auto-L4	2WD	Gasoline	station wagon	9.5	26	32	7	yes
2006	FORD Focus Station Wagon	2	(4 cyl)	Man-5	2WD	Gasoline	station wagon	9.5	26	34	7	yes
2006	FORD Focus Station Wagon	2	(4 cyl)	Auto-L4	2WD	Gasoline	station wagon	7	26	32	7	yes
2006	FORD Focus Station Wagon	2	(4 cyl)	Man-5	2WD	Gasoline	station wagon	7	26	34	7	yes
2006	FORD Fusion	2.3	(4 cyl)	Auto-L5	2WD	Gasoline	midsize car	9.5	24	32	7	yes
2006	FORD Fusion	2.3	(4 cyl)	Auto-L5	2WD	Gasoline	midsize car	7	24	32	7	yes
2007	FORD Ranger	2.3	(4 cyl)	Man-5	2WD	Gasoline	pickup	7	24	29	7	yes
2007	FORD Ranger	2.3	(4 cyl)	Auto-L5	2WD	Gasoline	pickup	7	21	26	6	yes
2006	FORD Ranger	2.3	(4 cyl)	Man-5	2WD	Gasoline	pickup	3	24	29	7	no
2006	FORD Ranger	2.3	(4 cyl)	Auto-L5	2WD	Gasoline	pickup	3	21	26	6	no
2007	GMC Canyon	2.9	(4 cyl)	Man-5	2WD	Gasoline	pickup	6	20	26	5	no
2007	GMC Canyon	2.9	(4 cyl)	Man-5	2WD	Gasoline	pickup	6	20	26	5	no
2006	GMC Canyon	2.8	(4 cyl)	Man-5	2WD	Gasoline	pickup	6	20	27	6	no
2006	GMC Canyon	2.8	(4 cyl)	Man-5	2WD	Gasoline	pickup	6	20	27	6	no
2007	GMC Savana 1500	4.3	(6 cyl)	Auto-L4	2WD	Gasoline	van	6	15	20	3	no
2007	GMC Savana 1500	5.3	(8 cyl)	Auto-L4	2WD	Gasoline	van	6	15	20	3	no
2006	GMC Savana 1500	5.3	(8 cyl)	Auto-L4	2WD	Gasoline	van	3	15	20	3	no
2006	GMC Savana 1500	4.3	(6 cyl)	Auto-L4	2WD	Gasoline	van	1	15	20	3	no
2006	GMC Savana 1500	4.3	(6 cyl)	Auto-L4	2WD	Gasoline	van	1	15	19	3	no
2007	GMC Savana 2500	4.3	(6 cyl)	Auto-L4	2WD	Gasoline	van	6	15	20	3	no
2007	GMC Savana 2500	5.3	(8 cyl)	Auto-L4	2WD	Gasoline	van	6	15	20	3	no
2006	GMC Savana 2500	5.3	(8 cyl)	Auto-L4	2WD	Gasoline	van	3	15	20	3	no
2006	GMC Savana 2500	4.3	(6 cyl)	Auto-L4	2WD	Gasoline	van	1	15	20	3	no

Year	Model	Displ	Cyl	Trans	Drive	Fuel	Veh Class	Air Pollution Score	City MPG	Hwy MPG	GHG Score	Smart Way Score
2006	GMC Savana 2500	4.3	(6 cyl)	Auto-L4	2WD	Gasoline	van	1	15	19	3	no
2007	HONDA Accord	2.4	(4 cyl)	Man-5	2WD	Gasoline	midsize car	6	26	34	7	yes
2007	HONDA Accord	2.4	(4 cyl)	Auto-L5	2WD	Gasoline	midsize car	9.5	24	34	7	yes
2007	HONDA Accord	2.4	(4 cyl)	Auto-L5	2WD	Gasoline	midsize car	6	24	34	7	yes
2006	HONDA Accord	2.4	(4 cyl)	Man-5	2WD	Gasoline	midsize car	6	26	34	7	yes
2006	HONDA Accord	2.4	(4 cyl)	Auto-L5	2WD	Gasoline	midsize car	9.5	24	34	7	yes
2006	HONDA Accord	2.4	(4 cyl)	Auto-L5	2WD	Gasoline	midsize car	6	24	34	7	yes
2006	HONDA Accord Hybrid	3	(6 cyl)	Auto-L5	2WD	Gasoline	midsize car	9.5	25	34	7	yes
2006	HONDA Civic	1.8	(4 cyl)	Man-5	2WD	Gasoline	small car	7	30	38	8	yes
2006	HONDA Civic	1.8	(4 cyl)	Auto-L5	2WD	Gasoline	small car	7	30	40	8	yes
2006	HONDA Civic	1.8	(4 cyl)	Auto-L5	2WD	CNG	small car	9.5	28	39	9	yes
2006	HONDA Civic Hybrid	1.3	(4 cyl)	Auto-AV	2WD	Gasoline	small car	9.5	49	51	10	yes
2006	HONDA CR-V	2.4	(4 cyl)	Auto-L5	2WD	Gasoline	SUV	6	23	29	6	no
2006	HONDA CR-V	2.4	(4 cyl)	Auto-L5	4WD	Gasoline	SUV	6	22	27	6	no
2006	HONDA Element	2.4	(4 cyl)	Auto-L4	2WD	Gasoline	SUV	6	22	26	6	no
2007	HONDA Fit	1.5	(4 cyl)	Man-5	2WD	Gasoline	station wagon	6	33	38	8	yes
2007	HONDA Fit	1.5	(4 cyl)	Auto-S5	2WD	Gasoline	station wagon	6	31	37	8	yes
2007	HONDA Fit	1.5	(4 cyl)	Auto-L5	2WD	Gasoline	station wagon	6	31	38	8	yes
2006	HONDA Insight	1	(3 cyl)	Man-5	2WD	Gasoline	small car	3	60	66	10	no
2006	HONDA Insight	1	(3 cyl)	Auto-AV	2WD	Gasoline	small car	9.5	57	56	10	yes
2007	HYUNDAI Accent	1.6	(4 cyl)	Man-5	2WD	Gasoline	small car	7	32	35	8	yes
2007	HYUNDAI Accent	1.6	(4 cyl)	Auto-L4	2WD	Gasoline	small car	7	28	37	8	yes
2006	HYUNDAI Accent	1.6	(4 cyl)	Man-5	2WD	Gasoline	small car	7	32	35	8	yes
2006	HYUNDAI Accent	1.6	(4 cyl)	Auto-L4	2WD	Gasoline	small car	7	28	36	8	yes
2007	HYUNDAI Elantra	2	(4 cyl)	Man-5	2WD	Gasoline	midsize car	7	28	36	8	yes
2007	HYUNDAI Elantra	2	(4 cyl)	Auto-L4	2WD	Gasoline	midsize car	7	28	36	8	yes
2006	HYUNDAI Elantra	2	(4 cyl)	Man-5	2WD	Gasoline	midsize car	7	27	34	8	yes
2006	HYUNDAI Elantra	2	(4 cyl)	Auto-L4	2WD	Gasoline	midsize car	9.5	24	32	7	yes
2006	HYUNDAI Elantra	2	(4 cyl)	Auto-L4	2WD	Gasoline	midsize car	9.5	24	32	7	yes
2006	HYUNDAI Elantra	2	(4 cyl)	Auto-L4	2WD	Gasoline	midsize car	7	24	32	7	yes
2007	HYUNDAI Sonata	2.4	(4 cyl)	Auto-L4	2WD	Gasoline	large car	7	24	33	7	yes
2007	HYUNDAI Sonata	2.4	(4 cyl)	Man-5	2WD	Gasoline	large car	7	24	34	7	yes
2007	HYUNDAI Tucson	2	(4 cyl)	Man-5	2WD	Gasoline	SUV	7	23	28	6	yes
2007	HYUNDAI Tucson	2	(4 cyl)	Auto-L4	2WD	Gasoline	SUV	7	22	27	6	yes
2007	HYUNDAI Tucson	2	(4 cyl)	Man-5	4WD	Gasoline	SUV	7	22	26	6	yes
2006	HYUNDAI Tucson	2	(4 cyl)	Auto-L4	2WD	Gasoline	SUV	3	22	27	6	no
2006	HYUNDAI Tucson	2	(4 cyl)	Man-5	2WD	Gasoline	SUV	3	22	27	6	no
2006	ISUZU I-280	2.8	(4 cyl)	Man-5	2WD	Gasoline	pickup	6	20	27	6	no
2007	ISUZU I-290	2.9	(4 cyl)	Man-5	2WD	Gasoline	pickup	6	20	26	5	no
2007	KIA Optima	2.4	(4 cyl)	Auto-L5	2WD	Gasoline	midsize car	7	24	34	7	yes
2007	KIA Optima	2.4	(4 cyl)	Man-5	2WD	Gasoline	midsize car	7	24	34	7	yes
2006	KIA Optima	2.4	(4 cyl)	Auto-L5	2WD	Gasoline	midsize car	7	24	34	7	yes
2006	KIA Optima	2.4	(4 cyl)	Man-5	2WD	Gasoline	midsize car	7	24	34	7	yes
2006	KIA Rio	1.6	(4 cyl)	Man-5	2WD	Gasoline	small car	7	32	35	8	yes
2006	KIA Rio	1.6	(4 cyl)	Auto-L4	2WD	Gasoline	small car	7	29	38	8	yes

Year	Model	Displ	Cyl	Trans	Drive	Fuel	Veh Class	Air Pollution Score	City MPG	Hwy MPG	GHG Score	Smart Way Score
2006	KIA Spectra	2	(4 cyl)	Auto-L4	2WD	Gasoline	midsize car	9.5	25	34	7	yes
2006	KIA Spectra	2	(4 cyl)	Man-5	2WD	Gasoline	midsize car	7	25	33	7	yes
2006	KIA Spectra	2	(4 cyl)	Auto-L4	2WD	Gasoline	midsize car	7	25	34	7	yes
2007	KIA Sportage	2	(4 cyl)	Man-5	2WD	Gasoline	SUV	7	23	28	6	yes
2007	KIA Sportage	2	(4 cyl)	Auto-L4	2WD	Gasoline	SUV	7	22	27	6	yes
2007	KIA Sportage	2	(4 cyl)	Man-5	4WD	Gasoline	SUV	7	22	26	6	yes
2006	KIA Sportage	2	(4 cyl)	Auto-L4	2WD	Gasoline	SUV	3	22	27	6	no
2006	KIA Sportage	2	(4 cyl)	Man-5	2WD	Gasoline	SUV	3	22	27	6	no
2006	LEXUS RX 400H	3.3	(6 cyl)	Auto-AV	2WD	Gasoline	SUV	9.5	33	28	8	yes
2006	LEXUS RX 400H	3.3	(6 cyl)	Auto-AV	4WD	Gasoline	SUV	9.5	31	27	7	yes
2007	MAZDA 3	2	(4 cyl)	Man-5	2WD	Gasoline	small car	9.5	28	35	8	yes
2006	MAZDA 3	2	(4 cyl)	Man-5	2WD	Gasoline	small car	9.5	28	35	8	yes
2007	MAZDA 5	2.3	(4 cyl)	Man-5	2WD	Gasoline	station wagon	6	22	27	6	no
2006	MAZDA 5	2.3	(4 cyl)	Man-5	2WD	Gasoline	station wagon	6	22	27	6	no
2007	MAZDA 6	2.3	(4 cyl)	Auto-S5	2WD	Gasoline	midsize car	9.5	24	31	7	yes
2007	MAZDA 6	2.3	(4 cyl)	Auto-S5	2WD	Gasoline	midsize car	6	24	31	7	yes
2007	MAZDA 6	2.3	(4 cyl)	Man-5	2WD	Gasoline	midsize car	6	24	32	7	yes
2006	MAZDA 6	2.3	(4 cyl)	Auto-S5	2WD	Gasoline	midsize car	9.5	24	31	7	yes
2006	MAZDA 6	2.3	(4 cyl)	Auto-S5	2WD	Gasoline	midsize car	6	24	31	7	yes
2007	MAZDA B2300	2.3	(4 cyl)	Man-5	2WD	Gasoline	pickup	7	24	29	7	yes
2007	MAZDA B2300	2.3	(4 cyl)	Auto-L5	2WD	Gasoline	pickup	7	21	26	6	yes
2006	MAZDA B2300	2.3	(4 cyl)	Man-5	2WD	Gasoline	pickup	3	24	29	7	no
2006	MAZDA B2300	2.3	(4 cyl)	Auto-L5	2WD	Gasoline	pickup	3	21	26	6	no
2006	MAZDA Tribute	2.3	(4 cyl)	Man-5	4WD	Gasoline	SUV	7	22	26	6	yes
2006	MAZDA Tribute Hybrid	2.3	(4 cyl)	Auto-AV	4WD	Gasoline	SUV	9.5	33	29	8	yes
2007	MERCURY Mariner	2.3	(4 cyl)	Auto-L4	2WD	Gasoline	SUV	6	23	26	6	no
2006	MERCURY Mariner	2.3	(4 cyl)	Auto-L4	2WD	Gasoline	SUV	6	22	26	6	no
2007	MERCURY Mariner Hybrid	2.3	(4 cyl)	Auto-AV	4WD	Gasoline	SUV	9.5	32	29	8	yes
2006	MERCURY Mariner Hybrid	2.3	(4 cyl)	Auto-AV	4WD	Gasoline	SUV	9.5	33	29	8	yes
2006	MERCURY Milan	2.3	(4 cyl)	Auto-L5	2WD	Gasoline	midsize car	9.5	24	32	7	yes
2006	MERCURY Milan	2.3	(4 cyl)	Auto-L5	2WD	Gasoline	midsize car	7	24	32	7	yes
2007	MERCURY Montego	3	(6 cyl)	Auto-L6	2WD	Gasoline	large car	6	21	29	6	no
2006	MINI Mini Cooper	1.6	(4 cyl)	Man-5	2WD	Gasoline	small car	2	28	36	8	no
2006	MINI Mini Cooper Convertible	1.6	(4 cyl)	Man-5	2WD	Gasoline	small car	2	27	35	8	no
2006	MITSUBISHI Lancer	2	(4 cyl)	Man-5	2WD	Gasoline	small car	7	27	34	8	yes
2006	MITSUBISHI Outlander	2.4	(4 cyl)	Man-5	2WD	Gasoline	SUV	2	22	28	6	no
2006	NISSAN Altima	2.5	(4 cyl)	Man-5	2WD	Gasoline	midsize car	9.5	24	31	7	yes
2006	NISSAN Altima	2.5	(4 cyl)	Man-5	2WD	Gasoline	midsize car	6	24	31	7	yes
2006	NISSAN Frontier	2.5	(4 cyl)	Man-5	2WD	Gasoline	pickup	7	22	25	6	yes
2006	NISSAN Sentra	1.8	(4 cyl)	Auto-L4	2WD	Gasoline	small car	6	28	34	8	yes
2006	NISSAN Sentra	1.8	(4 cyl)	Man-5	2WD	Gasoline	small car	6	28	35	8	yes
2007	NISSAN Versa	1.8	(4 cyl)	Man-6	2WD	Gasoline	midsize car	7	30	34	8	yes
2007	NISSAN Versa	1.8	(4 cyl)	Auto-AV	2WD	Gasoline	midsize car	7	30	36	8	yes
2007	NISSAN Versa	1.8	(4 cyl)	Auto-L4	2WD	Gasoline	midsize car	7	28	35	8	yes
2006	PONTIAC Vibe	1.8	(4 cyl)	Man-5	2WD	Gasoline	station wagon	7	30	36	8	yes

Year	Model	Displ	Cyl	Trans	Drive	Fuel	Veh Class	Air Pollution Score	City MPG	Hwy MPG	GHG Score	Smart Way Score
2006	PONTIAC Vibe	1.8	(4 cyl)	Auto-L4	2WD	Gasoline	station wagon	7	29	34	8	yes
2006	PONTIAC Vibe	1.8	(4 cyl)	Auto-L4	4WD	Gasoline	station wagon	2	26	31	7	no
2006	PONTIAC Vibe	1.8	(4 cyl)	Man-6	2WD	Gasoline	station wagon	2	25	32	7	no
2007	PONTIAC Wave	1.6	(4 cyl)	Man-5	2WD	Gasoline	small car	7	27	37	8	yes
2007	PONTIAC Wave	1.6	(4 cyl)	Man-5	2WD	Gasoline	small car	6	27	37	8	yes
2007	PONTIAC Wave 5	1.6	(4 cyl)	Man-5	2WD	Gasoline	small car	7	27	37	8	yes
2007	PONTIAC Wave 5	1.6	(4 cyl)	Man-5	2WD	Gasoline	small car	6	27	37	8	yes
2006	SAAB 9-2X	2.5	(4 cyl)	Auto-L4	4WD	Gasoline	station wagon	6	22	27	6	no
2006	SAAB 9-2X	2.5	(4 cyl)	Man-5	4WD	Gasoline	station wagon	6	22	29	6	no
2006	SAAB 9-3 Sportcombi	2	(4 cyl)	Auto-S5	2WD	Gasoline	station wagon	3	22	31	6	no
2006	SAAB 9-3 Sportcombi	2	(4 cyl)	Man-5	2WD	Gasoline	station wagon	3	22	31	6	no
2007	SATURN Vue	2.2	(4 cyl)	Man-5	2WD	Gasoline	SUV	6	23	29	6	no
2007	SATURN Vue	2.2	(4 cyl)	Auto-L4	2WD	Gasoline	SUV	6	22	27	6	no
2006	SATURN Vue	2.2	(4 cyl)	Man-5	2WD	Gasoline	SUV	3	23	29	6	no
2006	SATURN Vue	2.2	(4 cyl)	Auto-L4	2WD	Gasoline	SUV	3	22	27	6	no
2007	SATURN Vue Hybrid	2.4	(4 cyl)	Auto-L4	2WD	Gasoline	SUV	6	27	32	7	yes
2006	SUBARU Baja	2.5	(4 cyl)	Man-5	4WD	Gasoline	SUV	6	23	28	6	no
2007	SUBARU Forester	2.5	(4 cyl)	Auto-L4	4WD	Gasoline	SUV	9.5	23	28	6	yes
2007	SUBARU Forester	2.5	(4 cyl)	Auto-L4	4WD	Gasoline	SUV	6	23	28	6	no
2007	SUBARU Forester	2.5	(4 cyl)	Man-5	4WD	Gasoline	SUV	9.5	22	29	6	yes
2007	SUBARU Forester	2.5	(4 cyl)	Man-5	4WD	Gasoline	SUV	6	22	29	6	no
2006	SUBARU Forester	2.5	(4 cyl)	Auto-L4	4WD	Gasoline	SUV	6	23	28	6	no
2006	SUBARU Forester	2.5	(4 cyl)	Man-5	4WD	Gasoline	SUV	6	22	29	6	no
2007	SUBARU Impreza Wagon	2.5	(4 cyl)	Auto-L4	4WD	Gasoline	station wagon	6	23	28	6	no
2007	SUBARU Impreza Wagon	2.5	(4 cyl)	Man-5	4WD	Gasoline	station wagon	6	22	29	6	no
2006	SUBARU Impreza Wagon	2.5	(4 cyl)	Auto-L4	4WD	Gasoline	station wagon	6	23	28	6	no
2006	SUBARU Impreza Wagon	2.5	(4 cyl)	Man-5	4WD	Gasoline	station wagon	6	22	29	6	no
2007	SUBARU Legacy Wagon	2.5	(4 cyl)	Auto-S4	4WD	Gasoline	station wagon	9.5	23	30	7	yes
2007	SUBARU Legacy Wagon	2.5	(4 cyl)	Auto-S4	4WD	Gasoline	station wagon	6	23	30	7	yes
2007	SUBARU Legacy Wagon	2.5	(4 cyl)	Man-5	4WD	Gasoline	station wagon	9.5	22	29	6	yes
2007	SUBARU Legacy Wagon	2.5	(4 cyl)	Man-5	4WD	Gasoline	station wagon	6	22	29	6	no
2006	SUBARU Legacy Wagon	2.5	(4 cyl)	Auto-S4	4WD	Gasoline	station wagon	9.5	23	30	7	yes
2006	SUBARU Legacy Wagon	2.5	(4 cyl)	Auto-S4	4WD	Gasoline	station wagon	6	23	30	7	yes
2006	SUBARU Legacy Wagon	2.5	(4 cyl)	Man-5	4WD	Gasoline	station wagon	9.5	22	29	6	yes
2006	SUBARU Legacy Wagon	2.5	(4 cyl)	Man-5	4WD	Gasoline	station wagon	6	22	29	6	no
2007	SUBARU Outback	2.5	(4 cyl)	Auto-S4	4WD	Gasoline	SUV	9.5	22	28	6	yes
2007	SUBARU Outback	2.5	(4 cyl)	Auto-S4	4WD	Gasoline	SUV	6	22	28	6	no
2006	SUBARU Outback	2.5	(4 cyl)	Auto-S4	4WD	Gasoline	SUV	9.5	22	28	6	yes
2006	SUBARU Outback	2.5	(4 cyl)	Auto-S4	4WD	Gasoline	SUV	6	22	28	6	no
2007	SUBARU Outback Sport	2.5	(4 cyl)	Auto-L4	4WD	Gasoline	station wagon	6	23	28	6	no
2007	SUBARU Outback Sport	2.5	(4 cyl)	Man-5	4WD	Gasoline	station wagon	6	22	29	6	no
2006	SUBARU Outback Sport	2.5	(4 cyl)	Auto-L4	4WD	Gasoline	station wagon	6	23	28	6	no
2006	SUBARU Outback Sport	2.5	(4 cyl)	Man-5	4WD	Gasoline	station wagon	6	22	29	6	no
2007	SUBARU Outback Wagon	2.5	(4 cyl)	Man-5	4WD	Gasoline	SUV	9.5	23	28	6	yes
2007	SUBARU Outback Wagon	2.5	(4 cyl)	Man-5	4WD	Gasoline	SUV	6	23	28	6	no

Year	Model	Displ	Cyl	Trans	Drive	Fuel	Veh Class	Air Pollution Score	City MPG	Hwy MPG	GHG Score	Smart Way Score
2007	SUBARU Outback Wagon	2.5	(4 cyl)	Auto-S4	4WD	Gasoline	SUV	9.5	22	28	6	yes
2007	SUBARU Outback Wagon	2.5	(4 cyl)	Auto-S4	4WD	Gasoline	SUV	6	22	28	6	no
2006	SUBARU Outback Wagon	2.5	(4 cyl)	Man-5	4WD	Gasoline	SUV	9.5	23	28	6	yes
2006	SUBARU Outback Wagon	2.5	(4 cyl)	Man-5	4WD	Gasoline	SUV	6	23	28	6	no
2006	SUBARU Outback Wagon	2.5	(4 cyl)	Auto-S4	4WD	Gasoline	SUV	9.5	22	28	6	yes
2006	SUBARU Outback Wagon	2.5	(4 cyl)	Auto-S4	4WD	Gasoline	SUV	6	22	28	6	no
2007	SUZUKI Forenza Wagon	2	(4 cyl)	Man-5	2WD	Gasoline	station wagon	7	22	30	6	yes
2007	SUZUKI Forenza Wagon	2	(4 cyl)	Man-5	2WD	Gasoline	station wagon	6	22	30	6	no
2007	SUZUKI Swift	1.6	(4 cyl)	Man-5	2WD	Gasoline	small car	7	27	37	8	yes
2007	SUZUKI Swift	1.6	(4 cyl)	Man-5	2WD	Gasoline	small car	7	27	37	8	yes
2007	SUZUKI Swift	1.6	(4 cyl)	Man-5	2WD	Gasoline	small car	6	27	37	8	yes
2007	SUZUKI Swift	1.6	(4 cyl)	Man-5	2WD	Gasoline	small car	6	27	37	8	yes
2007	SUZUKI SX4	2	(4 cyl)	Auto-L4	2WD	Gasoline	station wagon	6	26	33	7	yes
2007	SUZUKI SX4	2	(4 cyl)	Auto-L4	4WD	Gasoline	station wagon	6	24	30	7	yes
2007	TOYOTA Camry	2.4	(4 cyl)	Auto-L5	2WD	Gasoline	midsize car	9.5	24	33	7	yes
2007	TOYOTA Camry	2.4	(4 cyl)	Auto-L5	2WD	Gasoline	midsize car	7	24	33	7	yes
2007	TOYOTA Camry	2.4	(4 cyl)	Man-5	2WD	Gasoline	midsize car	7	24	34	7	yes
2006	TOYOTA Camry	2.4	(4 cyl)	Auto-L5	2WD	Gasoline	midsize car	9.5	24	34	7	yes
2006	TOYOTA Camry	2.4	(4 cyl)	Man-5	2WD	Gasoline	midsize car	7	24	33	7	yes
2006	TOYOTA Camry	2.4	(4 cyl)	Auto-L5	2WD	Gasoline	midsize car	7	24	34	7	yes
2007	TOYOTA Camry Hybrid	2.4	(4 cyl)	Auto-AV	2WD	Gasoline	midsize car	9.5	40	38	9	yes
2007	TOYOTA Corolla	1.8	(4 cyl)	Man-5	2WD	Gasoline	small car	7	32	41	9	yes
2007	TOYOTA Corolla	1.8	(4 cyl)	Auto-L4	2WD	Gasoline	small car	7	30	38	8	yes
2006	TOYOTA Corolla	1.8	(4 cyl)	Man-5	2WD	Gasoline	small car	7	32	41	9	yes
2006	TOYOTA Corolla	1.8	(4 cyl)	Auto-L4	2WD	Gasoline	small car	7	30	38	8	yes
2006	TOYOTA Highlander	2.4	(4 cyl)	Auto-L4	2WD	Gasoline	SUV	2	22	27	6	no
2006	TOYOTA Highlander Hybrid	3.3	(6 cyl)	Auto-AV	2WD	Gasoline	SUV	9.5	33	28	8	yes
2006	TOYOTA Highlander Hybrid	3.3	(6 cyl)	Auto-AV	4WD	Gasoline	SUV	9.5	31	27	7	yes
2007	TOYOTA Matrix	1.8	(4 cyl)	Man-5	2WD	Gasoline	station wagon	7	30	36	8	yes
2007	TOYOTA Matrix	1.8	(4 cyl)	Auto-L4	2WD	Gasoline	station wagon	7	29	34	8	yes
2006	TOYOTA Matrix	1.8	(4 cyl)	Man-5	2WD	Gasoline	station wagon	7	30	36	8	yes
2006	TOYOTA Matrix	1.8	(4 cyl)	Auto-L4	2WD	Gasoline	station wagon	7	28	34	8	yes
2006	TOYOTA Matrix	1.8	(4 cyl)	Auto-L4	4WD	Gasoline	station wagon	2	26	31	7	no
2006	TOYOTA Matrix	1.8	(4 cyl)	Man-6	2WD	Gasoline	station wagon	2	25	32	7	no
2006	TOYOTA Prius	1.5	(4 cyl)	Auto-AV	2WD	Gasoline	midsize car	9.5	60	51	10	yes
2006	TOYOTA RAV4	2.4	(4 cyl)	Auto-L4	2WD	Gasoline	SUV	7	24	30	7	yes
2006	TOYOTA RAV4	2.4	(4 cyl)	Auto-L4	4WD	Gasoline	SUV	7	23	28	6	yes
2006	TOYOTA RAV4	3.5	(6 cyl)	Auto-L5	2WD	Gasoline	SUV	7	22	29	6	yes
2006	TOYOTA Scion XA	1.5	(4 cyl)	Man-5	2WD	Gasoline	small car	2	32	37	8	no
2006	TOYOTA Scion XA	1.5	(4 cyl)	Auto-L4	2WD	Gasoline	small car	2	31	38	8	no
2006	TOYOTA Scion XB	1.5	(4 cyl)	Man-5	2WD	Gasoline	station wagon	2	30	33	8	no
2006	TOYOTA Scion XB	1.5	(4 cyl)	Auto-L4	2WD	Gasoline	station wagon	2	30	34	8	no
2006	TOYOTA Tacoma	2.7	(4 cyl)	Auto-L4	2WD	Gasoline	pickup	6	21	26	6	no
2006	TOYOTA Tacoma	2.7	(4 cyl)	Auto-L4	2WD	Gasoline	pickup	6	21	26	6	no
2006	TOYOTA Tacoma	2.7	(4 cyl)	Man-5	2WD	Gasoline	pickup	6	20	27	6	no

Year	Model	Displ	Cyl	Trans	Drive	Fuel	Veh Class	Air Pollution Score	City MPG	Hwy MPG	GHG Score	Smart Way Score
2006	TOYOTA Tacoma	2.7	(4 cyl)	Man-5	2WD	Gasoline	pickup	6	20	27	6	no
2007	TOYOTA Yaris	1.5	(4 cyl)	Auto-L4	2WD	Gasoline	small car	7	34	39	9	yes
2007	TOYOTA Yaris	1.5	(4 cyl)	Man-5	2WD	Gasoline	small car	7	34	40	9	yes
2007	VOLKSWAGEN Passat Wagon	2	(4 cyl)	Auto-S6	2WD	Gasoline	station wagon	7	23	31	7	yes
2007	VOLVO V50	2.4	(5 cyl)	Auto-S5	2WD	Gasoline	station wagon	9.5	22	31	6	yes
2007	VOLVO V50	2.4	(5 cyl)	Man-5	2WD	Gasoline	station wagon	7	22	29	6	yes
2007	VOLVO V50	2.4	(5 cyl)	Auto-S5	2WD	Gasoline	station wagon	7	22	31	6	yes
2006	VOLVO V50	2.4	(5 cyl)	Auto-S5	2WD	Gasoline	station wagon	9.5	22	30	6	yes
2006	VOLVO V50	2.4	(5 cyl)	Man-5	2WD	Gasoline	station wagon	7	22	29	6	yes
2006	VOLVO V50	2.4	(5 cyl)	Auto-S5	2WD	Gasoline	station wagon	7	22	30	6	yes
2006	VOLVO V50	2.5	(5 cyl)	Auto-S5	2WD	Gasoline	station wagon	7	22	30	6	yes
2006	VOLVO V50	2.5	(5 cyl)	Man-6	2WD	Gasoline	station wagon	7	22	32	7	yes
2007	VOLVO V70	2.4	(5 cyl)	Man-5	2WD	Gasoline	station wagon	7	22	29	6	yes
2006	VOLVO V70	2.4	(5 cyl)	Man-5	2WD	Gasoline	station wagon	7	22	29	6	yes
2006	HYUNDAI Sonata	2.4	(4 cyl)	Auto-L4	2WD	Gasoline	large car	7	24	33	7	yes
2006	HYUNDAI Sonata	2.4	(4 cyl)	Man-5	2WD	Gasoline	large car	7	24	34	7	yes
2006	CHEVROLET Malibu Maxx	3.5	(6 cyl)	Auto-L4	2WD	Gasoline	large car	6	22	30	6	no
2006	TOYOTA Avalon	3.5	(6 cyl)	Auto-S5	2WD	Gasoline	large car	7	22	31	6	yes
2006	CHRYSLER 300	2.7	(6 cyl)	Auto-L4	2WD	Gasoline	large car	6	21	28	6	no
2006	CHRYSLER 300	2.7	(6 cyl)	Auto-L4	2WD	Gasoline	large car	3	21	28	6	no
2006	CHRYSLER SRT-8	2.7	(6 cyl)	Auto-L4	2WD	Gasoline	large car	6	21	28	6	no
2006	CHRYSLER SRT-8	2.7	(6 cyl)	Auto-L4	2WD	Gasoline	large car	3	21	28	6	no
2006	DODGE Charger	2.7	(6 cyl)	Auto-L4	2WD	Gasoline	large car	6	21	28	6	no
2006	DODGE Charger	2.7	(6 cyl)	Auto-L4	2WD	Gasoline	large car	3	21	28	6	no
2006	FORD Five Hundred	3	(6 cyl)	Auto-L6	2WD	Gasoline	large car	6	21	29	6	no
2006	MERCURY Montego	3	(6 cyl)	Auto-L6	2WD	Gasoline	large car	6	21	29	6	no

Glossary of Terms

Use this glossary of terms to explain terms and abbreviations used in the "Download Data".

Term	Definition
Displ	Engine displacement in liters
Cyl	Number of cylinders
Trans	Transmission type:

Code	Transmission Type Description
Auto-3	No Lockup/Automatic/3-speed
Auto-4	No Lockup/Automatic/4-speed
Auto-5	No Lockup/Automatic/5-speed
Auto-6	No Lockup/Automatic/6-speed
Auto-AV	Automatic variable gear ratios
Auto-L3	Lockup/Automatic/3-speed
Auto-L4	Lockup/Automatic/4-speed
Auto-L5	Lockup/Automatic/5-speed
Auto-L6	Lockup/Automatic/6-speed
Auto-L7	Lockup/Automatic/7-speed
Auto-S4	Semi-automatic 4-speed
Auto-S5	Semi-automatic 5-speed
Auto-S6	Semi-automatic 6-speed
Auto-S7	Semi-automatic 7-speed
Man-5	Manual 5-speed
Man-6	Manual 6-speed

Drive	Two-wheel drive = 2WD Four-wheel drive = 4WD
Veh Class	Vehicle class, e.g. SUV, pickup, midsize car, etc.
Air Pollution Score	The Air Pollution Score reflects pollutants that cause health problems and smog. The score is from 0 to 10, where 10 is best.
City MPG	Estimated miles-per-gallon in the city
Hwy MPG	Estimated miles-per-gallon on the highway
GHG Score	The Greenhouse Gas Score reflects the exhaust emissions of carbon dioxide. The score is from 0 to 10, where 10 is best.
SmartWay Score	SmartWay is given to those vehicles that score 6 or better on both the Air Pollution and Greenhouse Gas Scores, and have a total score when adding the two together of 13 or better.

Appendix J: Wind Resources from ECO Industries

AGREEMENT FOR ENERGY RELATED SERVICES

This Agreement is entered into between MUNICIPALITY a political subdivision of the Commonwealth of Massachusetts and ECO Industries, LLC for the provision of energy related services within the meaning of G.L. c. 30B, §1(b) (33) as inserted by 1997 Mass. St. c. 164, §58. Its purpose is to facilitate the application by MUNICIPALITY for an allocation of the clean renewable energy bond limitation under §54(f) of the federal Internal Revenue Code (hereinafter "CREB") by the current April 26, 2006 deadline. Said application will be for a so-called "qualified project" consisting of a wind facility under section 45(d)(1) of the Internal Revenue Code. Nothing contained herein obligates MUNICIPALITY to submit such an application or to undertake a qualified project if such an application is filed. Any applicable procurement laws, municipal ordinances, by-laws or operating procedures, including but not limited to G.L. c. 30B, will apply to the construction and operation of such a project.

Subject to those limitations, in consideration of their mutual undertakings and promises, the parties create a partnership for the financing, construction and operation of a wind facility. ECO Industries, LLC will prepare the requisite CREB application to be submitted by MUNICIPALITY and, if authorized to do so under the applicable procurement laws, construct and operate the wind facility. The wind facility will be owned by MUNICIPALITY. Under the Internal Revenue Code, at least 95 percent of the proceeds from any bond issue authorized by the federal Energy Tax Incentives Act of 2005 are to be used for capital expenditures incurred by MUNICIPALITY for the contemplated wind facility. To the extent the issuance of tax credit bonds fails to produce sufficient revenues to finance construction of the wind facility, ECO Industries, LLC will assist the owner in securing additional financing and the parties will equitably reduce MUNICIPALITY share of operating profits.

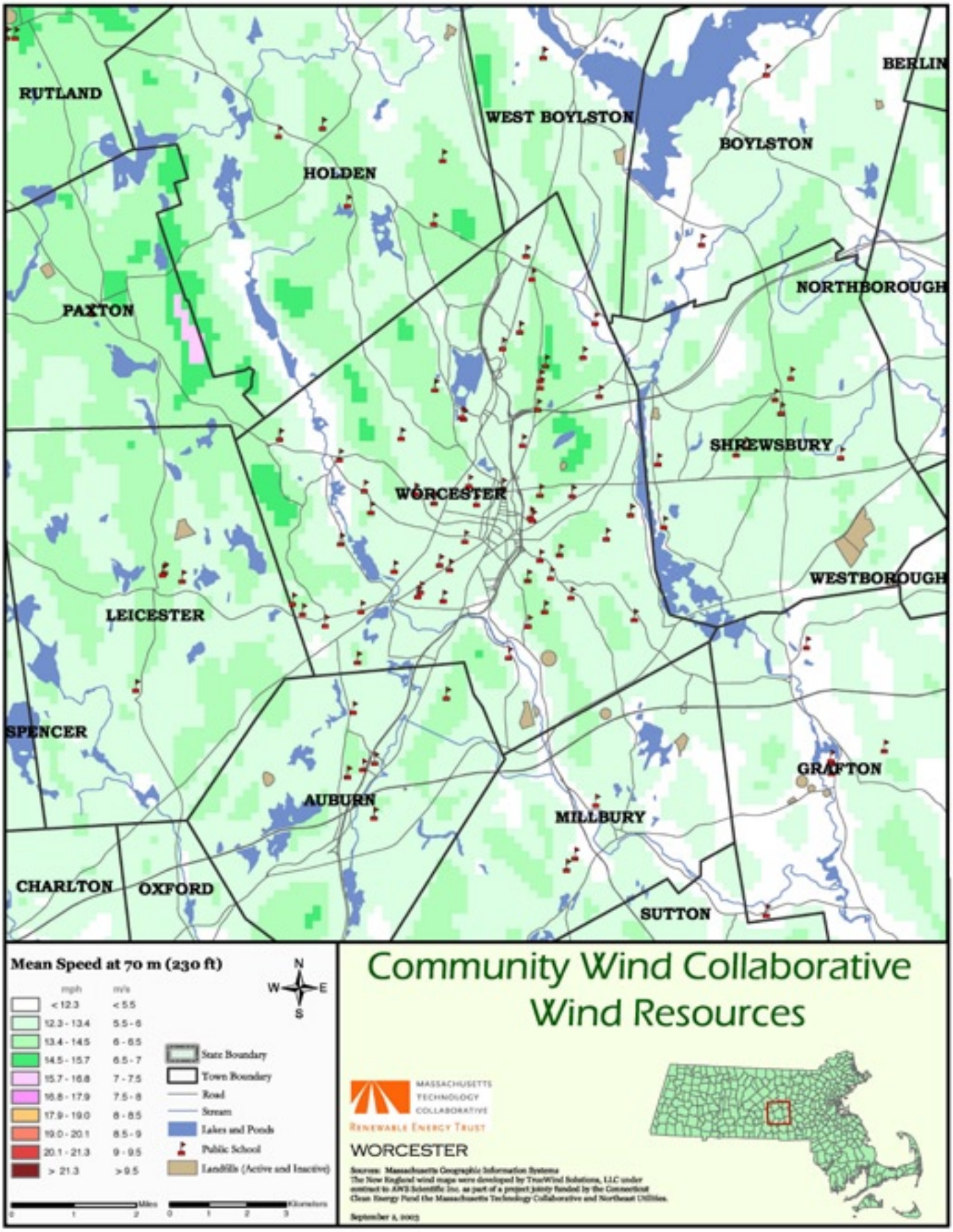
This Agreement reflects the entire agreement of the parties, but it is contemplated that more comprehensive contractual documents will be executed if the CREB application is successful and a wind facility project is undertaken. MUNICIPALITY may terminate this Agreement with or without cause, at any time prior to commencement of construction of the contemplated wind facility by withdrawing their application for an allocation from the IRS for a clean renewable energy bond and providing written notice thereof to ECO Industries, LLC, executed by the undersigned municipal office, employee or agent of MUNICIPALITY to Jay Cashman, Managing Member of ECO Industries, LLC.

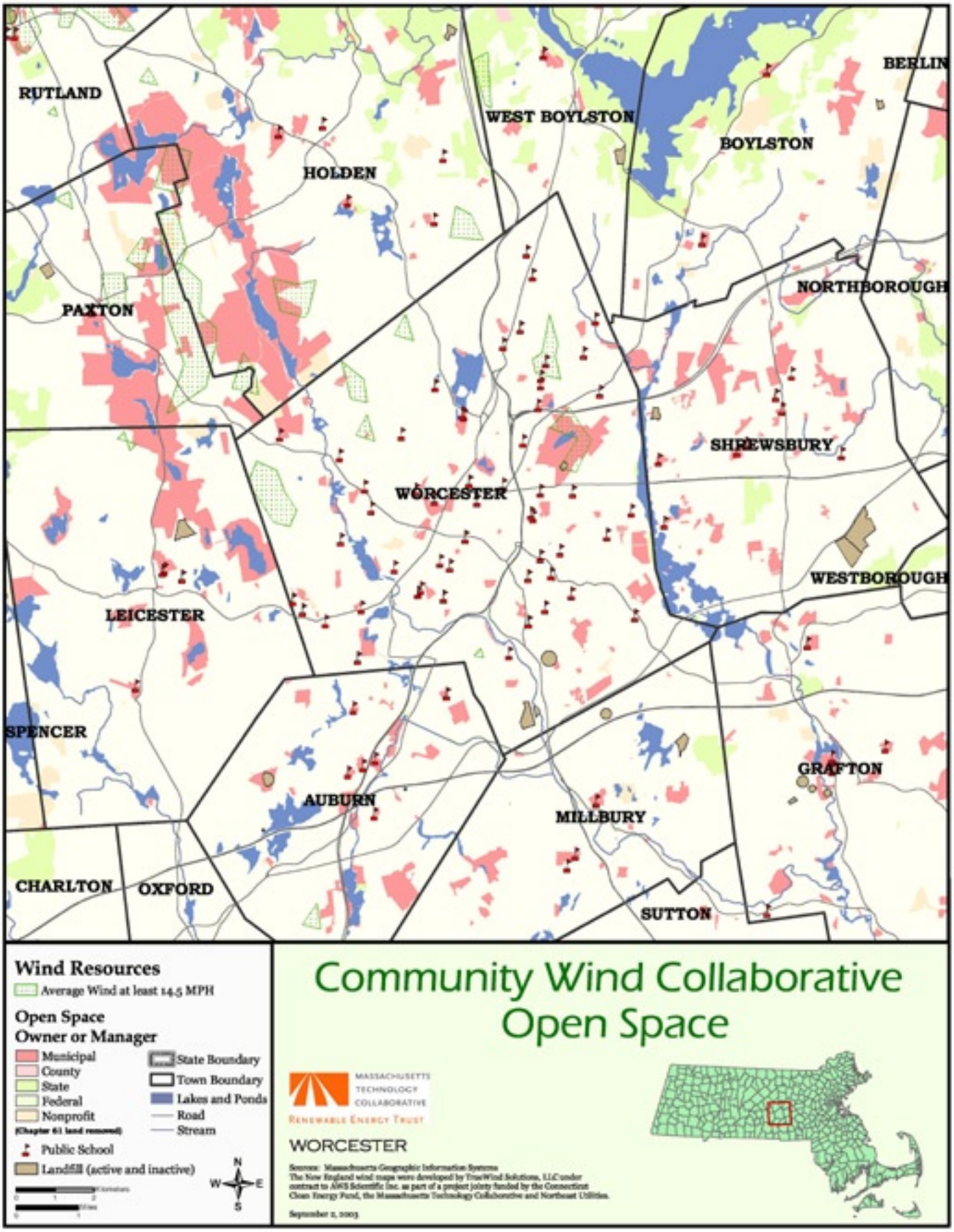
_____
MUNICIPALITY

By_____
(Title)

ECO Industries, LLC

By _____
Jay Cashman, Managing Member


RUTLAND
HOLDEN
WEST BOYLSTON
BOYLSTON
BERLIN
PAXTON
NORTHBOROUGH
SHREWSBURY
WORCESTER
WESTBOROUGH
LEICESTER
SPENCER
AUBURN
GRAFTON
MILLBURY
CHARLTON
OXFORD
SUTTON
Mean Speed at 70 m (230 ft)
mph
m/s
< 12.3
< 5.5
12.3 - 13.4
5.5 - 6
13.4 - 14.5
6 - 6.5
14.5 - 15.7
6.5 - 7
15.7 - 16.8
7 - 7.5
16.8 - 17.9
7.5 - 8
17.9 - 19.0
8 - 8.5
19.0 - 20.1
8.5 - 9
20.1 - 21.3
9 - 9.5
> 21.3
> 9.5
N
W
E
S
State Boundary
Town Boundary
Road
Stream
Lakes and Ponds
Public School
Landfills (Active and Inactive)
Miles
Kilometers
Community Wind Collaborative
Wind Resources
MASSACHUSETTS TECHNOLOGY COLLABORATIVE
RENEWABLE ENERGY TRUST
WORCESTER
Sources: Massachusetts Geographic Information Systems
The New England wind maps were developed by TrueWind Solutions, LLC under
contract to AWS Scientific Inc. as part of a project jointly funded by the Connecticut
Clean Energy Fund the Massachusetts Technology Collaborative and Northeast Utilities.
September 2, 2003


RUTLAND
HOLDEN
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BOYLSTON
BERLIN
PAXTON
NORTHBOROUGH
SHREWSBURY
WORCESTER
WESTBOROUGH
LEICESTER
SPENCER
AUBURN
MILLBURY
GRAFTON
CHARLTON
OXFORD
SUTTON
Wind Resources
Average Wind at least 14.5 MPH
Open Space
Owner or Manager
Municipal
County
State
Federal
Nonprofit
(Chapter 61 land removed)
Public School
Landfill (active and inactive)
State Boundary
Town Boundary
Lakes and Ponds
Road
Stream
N
W
E
S
Community Wind Collaborative
Open Space
MASSACHUSETTS TECHNOLOGY COLLABORATIVE
RENEWABLE ENERGY TRUST
WORCESTER
Sources: Massachusetts Geographic Information Systems
The New England wind maps were developed by TrueWind Solutions, LLC under contract to AWS Scientific Inc. as part of a project jointly funded by the Connecticut Clean Energy Fund, the Massachusetts Technology Collaborative and Northeast Utilities.
September 2, 2003

Appendix K: Hydro Power Price Quotes

CANYON HYDRO
5500 BLUE HERON LANE
DEMING, WA 98244

October 24, 2006

Ms. Carissa Williams
cleanenergy@recworcester.org
Worcester, MA

Dear Ms. Williams,

Thank you for your data sheet and for your interest in Canyon Hydro. We appreciate the opportunity to work with you on this project.

With an effective head of 55 feet and a design flow of 35.57 cfs, expected system production would be 100 KW, water to wire. Below is a brief description and budget estimate for our proposed stand alone power system equipment package.

Turbine: Canyon Custom designed Crossflow turbine. Turbine features shape machined and ground steel buckets, heat-treated and ground runner assembly, with flange mount roller bearings. Housing is heavy plate steel, with flanged base, integral generator mount, and intake to meet site requirements.

Generator: Marathon or equivalent, 125KW, 480 VAC, 3 ph., 60 Hz, 1800 rpm, brushless, synchronous, industrial generator, complete with gear drive assembly.

Governor: Thomson and Howe LCX electronic load control governor for constant oscillation free 480 VAC, 60 Hz current with over/under frequency protection.

Budget estimate, system as described $125,000.00

Budget estimates are offered for comparison purposes only, but are typically within 15% of an actual quotation for the same equipment.

The equipment above will be designed to meet the requirements of your project. Construction and materials are of the highest quality, and designs are tested and project proven.

I look forward to discussing this estimate with you. Please contact me if there any questions.

Sincerely,

Eric Melander

CANYON HYDRO

5500 BLUE HERON LANE
DEMING, WA 98244

October 24, 2006

Ms. Carissa Williams
cleanenergy@recworcester.org
Worcester, MA

Dear Ms. Williams,

Thank you for your site data and for your continued interest in Canyon Hydro. We appreciate the opportunity to work with you as you evaluate this project.

With an effective head of 100 feet and a design flow of 9.28 cfs, expected system production would be 48 KW, water to wire. Below is a brief description and budget estimate for our proposed stand alone power system equipment package.

Turbine: Canyon Custom designed Crossflow turbine. Turbine features shape machined and ground steel buckets, heat-treated and ground runner assembly, with flange mount roller bearings. Housing is heavy plate steel, with flanged base, integral generator mount, and intake to meet site requirements.

Generator: Marathon or equivalent, 58KW, 480 VAC, 3 ph., 60 Hz, 1800 rpm, brushless, synchronous, industrial generator, complete with gear drive assembly.

Governor: Thomson and Howe K2 electronic load control governor for constant oscillation free 480 VAC, 60 Hz current with over/under frequency protection.

Budget estimate, system price as described $70,000.00

Budget estimates are offered for comparison purposes only, but are typically within 15% of an actual quotation for the same equipment.

The equipment above will be designed to meet the requirements of your project. Construction and materials are of the highest quality, and designs are tested and project proven.

I look forward to discussing this estimate with you. Please contact me if there any questions.

Sincerely,

Eric Melander

Appendix L: Solar PV Case Studies from Mass Energy

To: Worcester Energy Task Force, Renewables Committee
From: Larry Chretien, Mass. Energy Consumers Alliance
Date: April 23, 2006
Re: Case Studies for Solar on Schools

Mass Energy was asked to produce case studies for projects Mass Energy administered involving solar installations on schools. Attached you will find three 2-page descriptions of projects we coordinated. All three were funded primarily by an MTC program that preceded MTC's current Small Renewables Initiative. The three case studies all involved installing ~ 2 kW systems on public schools. In all three cases, the systems are owned by the public school systems:

- Ø North Quincy High School – Quincy, MA. (a high school)
- Ø Boston Arts Academy – Boston, MA (a high school)
- Ø Murphy School – Boston, MA (an elementary school)

In all three cases, MTC paid $4.50 per watt, or about $9000. Today, the Small Renewables program provides about the same level of subsidy to an installation on a public building. The gross cost of the system at North Quincy was $19,000. It was installed in 2004. The gross cost of the systems in Boston were higher, each about $25,000, because they were done very recently (December 2005) and PV module costs have risen, particularly for small projects.

In North Quincy High's case, IBEW Local 103 donated the labor, valued at about $6500. The Quincy Rotary donated $1000. And the City of Quincy paid the balance of about $2500 in consideration of the fact that the payback period was going to be reasonable at that cost. On top of the PV array installations, MTC paid to install a "data acquisition system" (DAS) at North Quincy High School. The DAS is there to enhance the educational value of the system. The DAS is a CSG product called Soltrex. http://www.soltrex.com/. It was paid for by MTC through a pilot program which no longer exists.

In addition to MTC's grant of $8800, the Boston Arts Academy received a donation of $10,000 from a local foundation. The balance, about $6000, was paid out of Boston's CLEAN ENERGY CHOICE account with MTC. This account was built up by consumer payments for green power to Mass Energy.

In addition to MTC's grant of $8800, parents at The Murphy School raised and contributed $10,000. The balance, about $6000, was paid out of Boston's CLEAN ENERGY CHOICE account with MTC. This account was built up by consumer payments for green power to Mass Energy.

In Boston, stakeholders are looking into how their options for DAS.

In all three cases, the schools will be selling their renewable energy certificates (RECs) to Mass Energy, at a rate of 6 cents per kilowatt hour (about $150 per year). Mass Energy will include those RECs in the portfolio that comprises the product we offer to National Grid customers, which we call New England GreenStart℠ http://www.massenergy.com/Options.html.

Mass Energy is also assisting, as consultant, the City of Newton, which is releasing an RFP to install a ~ 2 kW system at the Oak Hill Middle School. We expect the installation to cost about $22,000. Of that, about $9000 will come from the Small Renewables program. The balance was originally expected to come from Newton's CLEAN ENERGY CHOICE account with MTC. The City of Newton purchases $20,000 in RECs per year from Mass Energy and has built up the largest CEC account in the state. However, Newton will receive a grant of $7500 from the Department of Environmental Protection (Mass Energy wrote the proposal on Newton's behalf). A DAS will be installed as well.

The City of Newton and Mass Energy are now discussing which school(s) to do next as CEC funds continue to accrue. Newton has not yet considered whether to sell the RECs from its systems.

Also with Mass Energy assistance as consultant, the Cape Light Compact is at work coordinating the installation of at least 21 systems on public schools on the Cape and Martha's Vineyard. Every town will receive at least one 2 kW system with DAS. We believe that there will be great benefits to aggregating this many systems at one time. In this case, the systems will be financed by a combination of MTC's Small Renewables program and CLEAN ENERGY CHOICE funds earned by each town. The CEC funds will earned as a result of payments made by consumers for Cape Light Compact Green, a green power product designed for the Compact by Mass Energy.

The RECs from the systems will be owned by the Compact and included in the portfolio for Cape Light Compact Green For more information about the Compact and its "Solar on Schools" program, http://www.capelightcompact.org/.

Finally, Worcester should consider these issues pertaining to solar on schools or other public property:

1. Can the City afford solar as a way to reach the City's goal of 20% by 2010?
2. Should solar on schools or public buildings be considered because of the educational value, either to students or the general public.
3. Should Worcester install many small systems or a few large systems, with the understanding that large systems have better economics?
4. Should Worcester retain its RECs for credit towards the 20% goal or sell them to earn revenue?
5. Is the City willing to host solar arrays that are owned by private investors who have the ability to take advantage of federal and state tax breaks?

Richard J. Murphy School

Dorchester, MA

Parent's Initiative Brings Solar Energy to Murphy School

The Richard J. Murphy School went into 2006 with the installation of solar electric panels (also known as photovoltaics or PV). The system uses semiconductor technology to convert sunlight into electricity. The 2.4 kilowatt (AC) system is expected to generate 2860 kilowatt hours of electricity for the school annually. This will offset about 3500 lbs. of carbon dioxide emissions, a cause of global warming.

The system consists of eight photovoltaic panels manufactured by RWE Schott Solar of Billerica, MA. A key component of the system, the inverter, was manufactured by Solectria Renewables, which is based in Woburn. The contractor was Lighthouse Electrical of Pembroke, Massachusetts. Clearly, the Murphy School installation is an example of how local jobs can be created in Massachusetts by renewable energy.

The project was coordinated by the Massachusetts Energy Consumers Alliance through an incentive program funded by the Massachusetts Technology Collaborative's (MTC) Renewable Energy Trust. A family at the Murphy School generously contributed $10,000. Without their initiation, this project would not have happened. In addition, funding was secured through MTC's CLEAN ENERGY CHOICE℠ program, which encourages voluntary contributions for renewable energy by providing matching grants to cities and towns. In particular, over 248 members of Mass Energy made contributions for "green power" totaling $7,060, which triggered a matching grant from MTC to the City of Boston. Through the office of Mayor Thomas Menino, those dollars were allocated to installing PV at the Murphy School and the Boston Arts Academy in the Fenway.

"As we prepare our students for careers of the future and 21st century life, we know that renewable energy will be a major force. We are fortunate to be on the cutting edge of this new enterprise."
-Mary L. Russo, Principal

Solar panels are an important part of the City's strategy to promote energy efficiency. They produce power without burning fossil fuels or producing pollution. Additionally, these panels will help lower energy costs for the city and the school department.
-Mayor Menino, Boston

In addition to producing energy for the school, the system will also be used to educate students about energy and environmental issues. A data acquisition system will be installed to provide educators and students an opportunity to learn hands on about the technology and benefits of renewable energy.

The solar invertor in the Murchpy school science lab

System Details

Installation Date: December 31, 2005
System Type: Photovoltaic (i.e. Solar Electric)
System Size: 2.64 kW DC; 2.376 kW AC
Module Manufacturer: RWE Schott Solar, Billerica, MA
Module Type: ASE 300
Number of Modules: 8
Inverter: Solectria 2500, Woburn, MA
Expected Annual Electrical Output: 2860 Kilo-watt-hours
Contractor: Lighthouse Electrical Contractors, Pembroke, MA

Building Green Power through Community Support

In addition to the upfront funding that came from the MTC, the installation at the Richard J. Murphy school is also subsidized by the customers of *New England GreenStart℠*, a product offered to customers of Mass. Electric by the Massachusetts Energy Consumers Alliance (Mass Energy). Through the purchase of renewable energy certificates, *New England GreenStart℠* encourages the development of clean energy projects such as the installation at the Richard J. Murphy school. Other projects, including the Hull Wind Turbine, small hydro-electric dams, landfill gas facilities, and a number of solar installations, also receive support through this program. For more information, visit www.massenergy.com.

New England GreenStart
Feel good about your electricity.

Special Thanks to Project Sponsors:

International Brotherhood of Electrical Workers

SolarBoston

Bostonia Condita A.D. 1630

Massachusetts Technology Collaborative
Renewable Energy Trust

Lighthouse Electrical Contracting Inc.

Mass Energy Consumers Alliance
A Non-Profit Organization

Solar Fenway
Solar Fenway Demonstration Project
"Turning the vision of a sustainable community into action!"

Urban Environmental Accords

Signed on the occasion of United Nations Environment Programme World Environment Day
June 5th, 2005 in San Francisco, California

Green Cities Declaration

RECOGNIZING for the first time in history, the majority of the planet's population now lives in cities and that continued urbanization will result in one million people moving to cities each week, thus creating a new set of environmental challenges and opportunities; and

BELIEVING that as Mayors of cities around the globe, we have a unique opportunity to provide leadership to develop truly sustainable urban centers based on culturally and economically appropriate local actions; and

RECALLING that in 1945 the leaders of 50 nations gathered in San Francisco to develop and sign the Charter of the United Nations; and

ACKNOWLEDGING the importance of the obligations and spirit of the 1972 Stockholm Conference on the Human Environment, the 1992 Rio Earth Summit (UNCED), the 1996 Istanbul Conference on Human Settlements, the 2000 Millennium Development Goals, and the 2002 Johannesburg World Summit on Sustainable Development, we see the Urban Environmental Accords described below as a synergistic extension of the efforts to advance sustainability, foster vibrant economies, promote social equity, and protect the planet's natural systems.

THEREFORE, BE IT RESOLVED, today on World Environment Day 2005 in San Francisco, we the signatory Mayors have come together to write a new chapter in the history of global cooperation. We commit to promote this collaborative platform and to build an ecologically sustainable, economically dynamic, and socially equitable future for our urban citizens; and

BE IT FURTHER RESOLVED that we call to action our fellow Mayors around the world to sign the Urban Environmental Accords and collaborate with us to implement the Accords; and

BE IT FURTHER RESOLVED that by signing these Urban Environmental Accords, we commit to encourage our City governments to adopt these Accords and commit our best efforts to achieve the Actions stated within. By implementing the Urban Environmental Accords, we aim to realize the right to a clean, healthy, and safe environment for all members of our society.

Implementation & Recognition

THE 21 ACTIONS that comprise the Urban Environmental Accords are organized by urban themes. They are proven first steps toward environmental sustainability. However, to achieve long-term sustainability, cities will have to progressively improve performance in all thematic areas.

Implementing the Urban Environmental Accords will require an open, transparent, and participatory dialogue between government, community groups, businesses, academic institutions, and other key partners. Accords implementation will benefit where decisions are made on the basis of a careful assessment of available alternatives using the best available science.

The call to action set forth in the Accords will most often result in cost savings as a result of diminished resource consumption and improvements in the health and general well-being of city residents. Implementation of the Accords can leverage each city's purchasing power to promote and even require responsible environmental, labor and human rights practices from vendors.

Between now and the World Environment Day 2012, cities shall work to implement as many of the 21 Actions as possible. The ability of cities to enact local environmental laws and policies differs greatly. However, the success of the Accords will ultimately be judged on the basis of actions taken. Therefore, the Accords can be implemented though programs and activities even where cities lack the requisite legislative authority to adopt laws.

The goal is for cities to pick three actions to adopt each year. In order to recognize the progress of cities to implement the Accords, a *City Green Star Program* shall be created.

At the end of the seven years a city that has implemented:

19 – 21 Actions shall be recognized as a ★★★★ City
15 – 18 Actions shall be recognized as a ★★★ City
12 – 17 Actions shall be recognized as a ★★ City
8 – 11 Actions shall be recognized as a ★ City

ENERGY
Renewable Energy · Energy Efficiency · Climate Change

WASTE REDUCTION
Zero Waste · Manufacturer Responsibility · Consumer Responsibility

URBAN DESIGN
Green Building · Urban Planning · Slums

URBAN NATURE
Parks · Habitat Restoration · Wildlife

TRANSPORTATION
Public Transportation · Clean Vehicles · Reducing Congestion

ENVIRONMENTAL HEALTH
Toxics Reduction · Healthy Food Systems · Clean Air

WATER
Water Access & Efficiency · Source Water Conservation · Waste Water Reduction

ENERGY

Action 1 Adopt and implement a policy to increase the use of renewable energy to meet ten per cent of the city's peak electric load within seven years.
Action 2 Adopt and implement a policy to reduce the city's peak electric load by ten per cent within seven years through energy efficiency, shifting the timing of energy demands, and conservation measures.
Action 3 Adopt a citywide greenhouse gas reduction plan that reduces the jurisdiction's emissions by twenty-five per cent by 2030, and which includes a system for accounting and auditing greenhouse gas emissions.

WASTE REDUCTION

Action 4 Establish a policy to achieve zero waste to landfills and incinerators by 2040.
Action 5 Adopt a citywide law that reduces the use of a disposable, toxic, or non-renewable product category by at least fifty percent in seven years.
Action 6 Implement "user-friendly" recycling and composting programs, with the goal of reducing by twenty per cent per capita solid waste disposal to landfill and incineration in seven years.

URBAN DESIGN

Action 7 Adopt a policy that mandates a green building rating system standard that applies to all new municipal buildings.
Action 8 Adopt urban planning principles and practices that advance higher density, mixed use, walkable, bikeable and disabled-accessible neighborhoods which coordinate land use and transportation with open space systems for recreation and ecological restoration.
Action 9 Adopt a policy or implement a program that creates environmentally beneficial jobs in slums and/or low-income neighborhoods.

URBAN NATURE

Action 10 Ensure that there is an accessible public park or recreational open space within half-a-kilometer of every city resident by 2015.
Action 11 Conduct an inventory of existing canopy coverage in the city; and, then establish a goal based on ecological and community considerations to plant and maintain canopy coverage in not less than fifty per cent of all available sidewalk planting sites.
Action 12 Pass legislation that protects critical habitat corridors and other key habitat characteristics (e.g. water features, food-bearing plants, shelter for wildlife, use of native species, etc.) from unsustainable development.

TRANSPORTATION

Action 13 Develop and implement a policy which expands affordable public transportation coverage to within half-a-kilometer of all city residents in ten years.
Action 14 Pass a law or implement a program that eliminates leaded gasoline (where it is still used); phases down sulfur levels in diesel and gasoline fuels, concurrent with using advanced emission controls on all buses, taxis, and public fleets to reduce particulate matter and smog-forming emissions from those fleets by fifty per cent in seven years.
Action 15 Implement a policy to reduce the percentage of commute trips by single occupancy vehicles by ten per cent in seven years.

ENVIRONMENTAL HEALTH

Action 16 Every year, identify one product, chemical, or compound that is used within the city that represents the greatest risk to human health and adopt a law and provide incentives to reduce or eliminate its use by the municipal government.
Action 17 Promote the public health and environmental benefits of supporting locally grown organic foods. Ensure that twenty per cent of all city facilities (including schools) serve locally grown and organic food within seven years.
Action 18 Establish an Air Quality Index (AQI) to measure the level of air pollution and set the goal of reducing by ten per cent in seven years the number of days categorized in the AQI range as "unhealthy" or "hazardous."

WATER

Action 19 Develop policies to increase adequate access to safe drinking water, aiming at access for all by 2015. For cities with potable water consumption greater than 100 liters per capita per day, adopt and implement policies to reduce consumption by ten per cent by 2015.
Action 20 Protect the ecological integrity of the city's primary drinking water sources (i.e., aquifers, rivers, lakes, wetlands and associated ecosystems).
Action 21 Adopt municipal wastewater management guidelines and reduce the volume of untreated wastewater discharges by ten per cent in seven years through the expanded use of recycled water and the implementation of a sustainable urban watershed planning process that includes participants of all affected communities and is based on sound economic, social, and environmental principles.

Appendix N: How To Use BioDiesel

The American Society for Testing and Materials (ASTM) has developed specifications for B-100 that will be blended with diesel fuel to make low-level biodiesel blends. ASTM specification D6751-03 is intended to ensure the quality of biodiesel used in the United States, and any biodiesel used for blending should meet this specification. Biodiesel meeting ASTM D6751-03 is also legally registered as a fuel and fuel additive with the U.S. Environmental Protection Agency. In addition, the National Biodiesel Board has instituted a BQ-9000 quality assurance program for biodiesel producers and marketers.

Technical Recommendations for B-20 Fleet Use[14, 15]

Ensure the biodiesel meets the ASTM specification for pure biodiesel (ASTM D 6751) before blending with petrodiesel.

Purchase biodiesel and biodiesel blends only from companies that have been registered under the BQ-9000 fuel quality program.

Ensure the B-20 blend meets properties for ASTM D 975, Standard Specification for Diesel Fuel Oils or the ASTM specification for B-20 once it is approved.

Ensure your B-20 supplier provides a homogenous product.

Avoid long term storage of B-20 to prevent degradation.

Biodiesel should be used within six months. If using B-20 in seasonal operations where fuel is not used within 6 months, consider storage-enhancing additives or flushing with diesel fuel prior to storage.

Prior to transitioning to B-20, tanks should be cleaned and free from sediment and water.

Check for water and drain regularly if needed. Monitor for microbial growth and treat with biocides as recommended by the biocide manufacturer. See the NREL Biodiesel Storage and Handling Guidelines for further information http://www.nrel.gov/vehiclesandfuels/npbf/pdfs/tp36182.pdf.

Be Aware of the Fuel Filters upon Initial Use

Fuel filters on the vehicles and in the delivery system may need to be changed more frequently upon initial B-20 use. Biodiesel and biodiesel blends have excellent cleaning properties. The use of B-20 can dissolve sediments in the fuel system and result in the need to change filters more frequently when first using biodiesel until the whole system has been cleaned of the deposits left by the petrodiesel.

Be aware of B-20's cold weather properties and take appropriate precautions.

When operating in winter climates, use winter-blended diesel fuel. If B-20 is to be used in winter months, make sure the B-20 cloud point is adequate for the geographical region and time of year the fuel will be used.

Perform regularly scheduled maintenance

as dictated by the engine operation and maintenance manual.

Be aware of biodiesel's compatibility with engine components.

The switch to low sulfur diesel fuel has caused most OEMs to switch to components suitable for use with biodiesel, but users should contact their OEM for specific information. In general, pure biodiesel will soften and degrade certain types of elastomers and natural rubber compounds over time. Using high percent blends can impact fuel system components (primarily fuel hoses and fuel pump seals) that contain elastomer

compounds incompatible with biodiesel. Manufacturers recommend that natural or butyl rubbers not be allowed to come in contact with pure biodiesel. Blends of B-20 or lower have not exhibited elastomer degradation and need no changes. If a fuel system does contain these materials and users wish to fuel with blends over B-20, replacement with compatible elastomers is recommended.

Wipe painted surfaces immediately when using biodiesel.

Since biodiesel is a good solvent, it can, if left on a painted surface long enough, dissolve certain types of paints. Therefore, it is recommended to wipe any biodiesel or biodiesel blend spills from painted surfaces immediately.

Store biodiesel or biodiesel blend soaked rags in a safety can to avoid spontaneous combustion.

Biodiesel soaked rags should be stored in a safety can or dried individually to avoid the potential for spontaneous combustion. Biodiesel is made from vegetable oils or animal fats that can oxidize and degrade over time. This oxidizing process can produce heat. In some environments a pile of oil- soaked rags can develop enough heat to result in a spontaneous fire.

[14] National Biodiesel Board, "Technical Recommendations for the Use of B-20", June 2005, www.biodiesel.org, Accessed October 2005, authored by the B-20 Fleet Evaluation Team. B-20 Fleet Evaluation Team Members: Cummins, John Deere, International Truck and Engine Corp, DaimlerChrysler, Caterpillar, Ford Motor Company, General Motors, Department of Defense, Siemens, Delphi Automotive Systems, Volkswagen, Engine Manufacturers Association, MARC-IV Consulting, ASG Renaissance, Bosch, FleetGuard, NREL, BMW of North America, Mack Trucks, Stanadyne Automotive Corporation, Suncor, CNH Global, Parker-Hannifin-Racor Division, and DENSO International America.

[15] National Biodiesel Board, "Biodiesel Usage Checklist", www.biodiesel.org, Accessed October 2005.

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Front cover: sun, water, wind turbines, field, www.epa.gov/greenpower/whatis/renewableenergy.htm
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Page 28: Northeast, Amherst, MA Climate Action Plan October 2005
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