Energy Efficiency and Conservation Plan

Bridgeport, Connecticut

Regional Plan Association

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Plan developed by:

Regional Plan Association

BGreen Staff:
Evelyn Lee, Project Associate
Matt Thurston, Research Assistant
David Kooris, Vice President, Connecticut Director
Amanda Kennedy, Associate Planner

2 Landmark Square Suite 108
Stamford, CT 06901
203-356-0390
4 Irving Place 7th Floor
New York, NY 10003
212-253-2727
www.rpa.org
www.bgreenbridgeport.org
twitter: @BGreenBPT
www.facebook.com/bgreenbridgeport

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EXECUTIVE SUMMARY

INTRODUCTION

The Energy Efficiency and Conservation Plan outlines a realistic and implementation-oriented means to reduce energy use for Bridgeport's government, employers, and residents, and transition to a cleaner energy sources that will reduce Bridgeport's carbon emissions by 30% by 2030. To ensure the future wellbeing of its people, resources and economy, Bridgeport, like cities around the world, must create an aggressive carbon reduction plan.

The Energy Efficiency and Conservation Plan projects carbon reduction even while accommodating aggressive growth in jobs and population in the City. Under current energy trends, growth would increase annual carbon emissions by 240,000 metric tons CO2e ($MTCO_2e$) *above* its inventory baseline year of 2007 by 2030. Meeting our 30% target will require a reduction in future emissions by 540,000 $MTCO_2e$ by 2030.

Green Buildings strategies will contribute energy savings early during implementation of the plan, supplemented over time by an increase in renewable energy, but, more importantly, with a reduction in transportation emissions and emphasis on smart growth. Waste management and water resources contribute seemingly minimal savings, but full benefit of their actions is greater than at first glance.

Conservative estimates predict annual savings of over $225 million in energy costs associated with Plan measures, and, in similarly conservative vein, the creation of at minimum 6,900 fulltime equivalent work years, putting the emphasis of a green economy on *the economy*.

BACKGROUND

Bridgeport, Connecticut's Energy Efficiency and Conservation Plan builds upon a year-long comprehensive sustainability planning, BGreen 2020, which was launched by an Executive Order signed by Mayor Bill Finch on October 24, 2008. The Order established a Sustainability Community Advisory Committee composed of nearly forty community leaders to oversee the BGreen 2020 initiative and direct city-wide sustainability actions. A subsequent Memorandum of Understanding between The City of Bridgeport and the Bridgeport Regional Business Council created BGreen 2020 as a public/private partnership in December 2008. As part of this partnership, five technical subcommittees, with fifteen to twenty stakeholders each, were charged with developing sustainability strategies in the following BGreen 2020 program areas:

Greenfields and Green Wheels (land use and transportation)
Green Spaces, Recycling, and Water Resources
Green Energy and Buildings
Green Businesses, Jobs and Purchasing
Green Marketing, Education and Outreach

The resulting strategies are incorporated into a citywide BGreen 2020 Sustainability Plan. Since many of these committee-developed strategies have significant implications for reduced energy use, the BGreen Plan can be viewed broadly as a comprehensive Energy Efficiency and Conservation Plan. However, to have greatest impact and to more clearly direct and motivate municipal and community actions, strategies outlined in the BGreen Plan were combined with results of Bridgeport's 2007 Greenhouse Gas Inventory, conducted for the city in 2008, so as to develop a more targeted Energy Efficiency and Conservation Plan.

GREENHOUSE GAS EMISSIONS, SETTING TARGETS, AND FOCUSING REDUCTIONS

A. Current Emissions

Bridgeport's 2007 emissions were 997,799 metric tons CO2e.[1] Municipal facilities and operations accounted for slightly less than 4% of this total. While municipal leadership is essential to this energy plan, communitywide actions are equally essential to making needed progress toward GHG reductions goals.

B. Setting Targets: What Level of Action is Required?

Varying greenhouse gas reduction targets have been established by different governmental or quasi-governmental entities. At the 73rd Annual Meeting of the United States Conference of Mayors in Chicago on June 10-14, 2005, mayors from cities nationwide created the Mayor's Climate Protection Agreement as a means for taking local action in reducing greenhouse gas emissions. This agreement, to which Bridgeport is a participating city, includes a commitment to meet or beat provisions of the internationally-recognized Kyoto Protocol. The Kyoto Protocol targeted a seven percent greenhouse gas emissions reduction from 1990 levels by 2012.

By Executive Order of Mayor Bill Finch signed October 24, 2008, (the same Executive Order which created the BGreen 2020 Initiative) the City reinforced its commitment to Kyoto Protocol goals, with targets of seven percent below 1990 levels by 2012, and ten percent below 1990 levels by 2020. This seemingly supports and expands upon the goal set forth in the City's Master Plan of Conservation and Development of a ten percent reduction by 2020, although the Master Plan does not specify a baseline date.

In more recent action, Public Act 08-98 of the State of Connecticut *mandated* attainment of the following maximum emissions for the State: (1) Not later than January 1, 2020, a level at least ten percent below the level emitted in 1990; and (2) Not later than January 1, 2050, a level at least eighty percent below the level emitted in 2001.

At the Federal level, the United States House of Representatives, in June 2009, passed the American Clean Energy and Security Act, which looked to reduce emissions three percent by 2012, 17 percent by 2020, 42

percent by 2030, and 83 percent by 2050, all using 2005 emissions as the baseline. Under provisions of this Act, certain subject industries would be required to limit emissions based on a cap and trade system. This Act was not signed into law; discussions under separate legislative session are ongoing.

TABLE 1 Comparison of Recognized GHG Emission Reduction Targets

	Baseline	2012	2020	2030	2050
Bridgeport CT Executive Order	1990	7% reduction	10% reduction		
Bridgeport Municipal Plan	Not specified		10% reduction		
Kyoto Protocol and Conference of Mayors	1990	7% reduction			
Connecticut PA 08-98	1990 & 2001		10% reduction below 1990		80% reduction below 2001
Federal Legislation – House Bill 6/09	2005	3% reduction	17% reduction	42% reduction	83% reduction

C. Analyzing Growth to Establish Bridgeport's Emissions Reduction Target

Energy strategies to reduce future emissions must consider the potential growth in energy use that comes from increases in population and employment. This Energy Plan considers both a population-based approach and sector-based approach to predicting growth and establishing emissions reduction targets for Bridgeport. Under each, two different growth scenarios- Low Growth (following growth trends of the last several decades) and high growth (expected from demographic shifts that favor urban environments) are analyzed (See Appendix for full description of emissions projection scenarios).

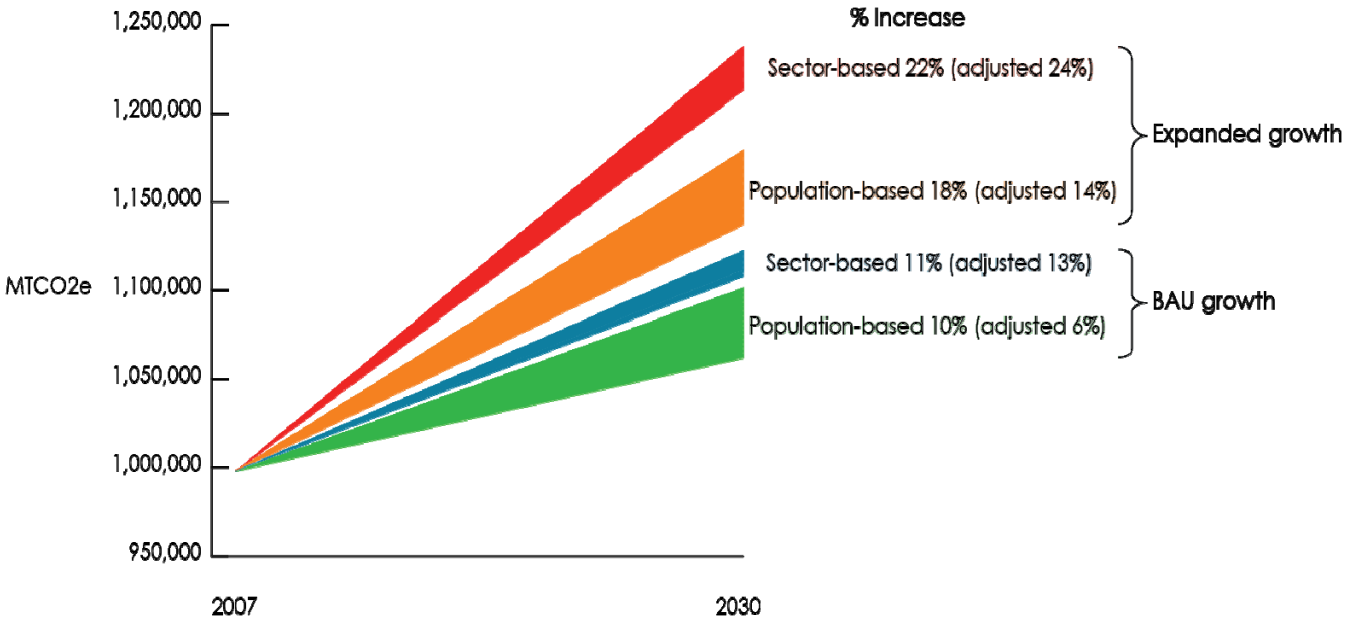
This Bridgeport Energy Plan ultimately targets emissions reductions using the Sector-based, High Growth projection, which is the most aggressive growth projection of all scenarios and requires the largest emissions reduction. Under this scenario, by 2030 Bridgeport will add 15,623 households, which are 8,000 more than State projections. It will also add 27,500 more jobs, which is almost double the projection of nearly 15,000[2].

Projected emissions under this scenario equal 1,237,688 metric tons CO2e. This represents an increase of 239,889 MTCO2e over 2007 baseline emissions.

The *High Growth Scenario* takes into account expected development of housing and commercial real estate enabled by new zoning regulations enacted by the City of Bridgeport in 2009. Even in this currently constrained economy, Bridgeport is poised and expected to grow. Redevelopment will increase Bridgeport emissions. Favorably, redevelopment will occur at a time when we have our most efficient energy systems and building codes ever. Also, favorably, Bridgeport growth represents potential to avoid growth-related

emissions in other towns. Growth in Bridgeport is the epitome of "smart growth," placing more compact, transit-accessible residential and commercial opportunities in infill locations instead of on suburban greenfields. To the extent that avoided sprawl may or may not be realized, this Energy Plan establishes strict goals for reducing emissions under this second, more intensive Growth Scenario, and for Bridgeport taking responsibility for reducing emissions to designated levels even in the face of expected increases in households and employment.

Projected Emissions, 2007-2030



This Energy Plan sets a goal of reducing emissions to a level, which is 30% below Bridgeport's 2007 baseline by the year 2030- an ultimate reduction of 539,228 MTCO2e in annual emissions. This will bring the City's emissions to 698,459 MTCO2e per year.

This Energy Plan outlines the means to achieve a reduction of 549,766 MTCO2e by 2030, exceeding very slightly the long-term target. Additional reductions, noted but not quantified by this plan, are also anticipated. The following interim goals are recommended.

2007 Baseline annual emissions	**997,799**	**$MTCO_2e$**
2030 Projected annual emissions	**1,237,688**	**$MTCO_2e$**

2030 Annual emissions target	**698,459**	**$MTCO_2e$**
Reduction necessary to reach target	**539,229**	**$MTCO_2e$ by 2030**
Reduction outlined in this plan	**549,766**	**$MTCO_2e$ by 2030**

Table 2 Bridgeport CO2e Interim Reduction Targets Compared with 2007 Baseline Emissions

Year	Low Growth MTCO2e	High Growth MTCO2e	Represents	Emissions Goal MTCO2e
2015	-143,129	-183,219	10% under 2007	898,019
2020	-270,002	-335,149	20% under 2007	798,239
2025	-396,874	-487,079	30% under 2007	698,459
2030	-423,967	-539,228	30% under 2007	698,459

D. Identifying Reduction Potential and Focusing Reductions

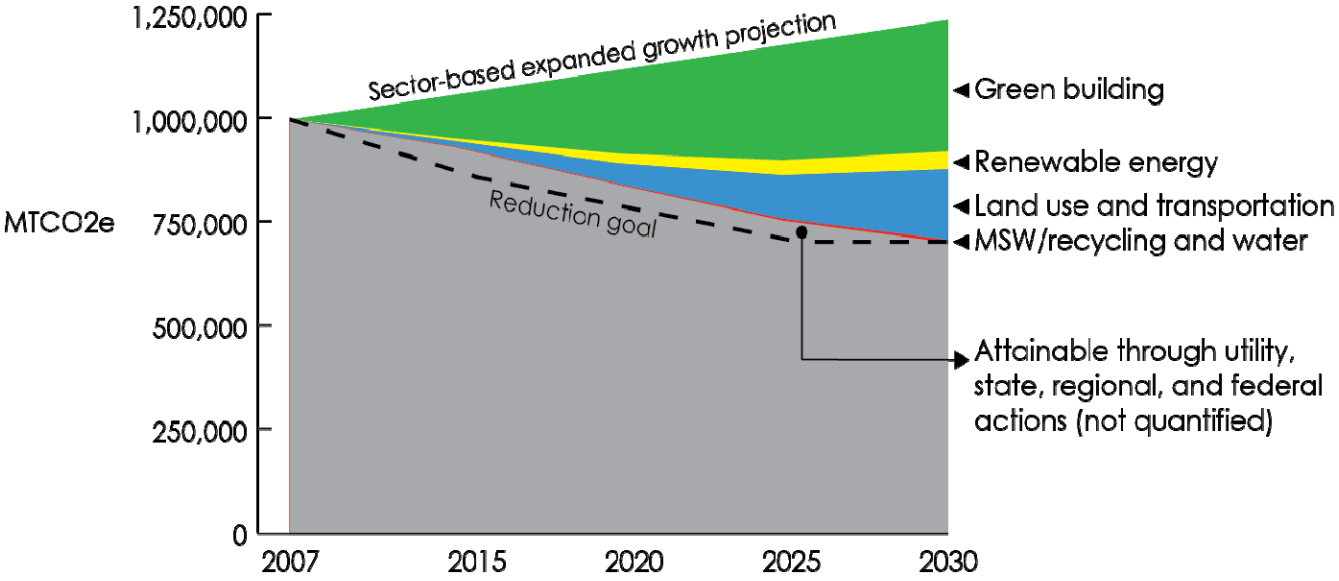
Potential Emissions Reduction, 2007-2030

Bridgeport will meet its emission reduction targets by focusing strategies in the following areas and with the noted distribution.[1]

	Annual savings potential (MTCO2e) by 2030	Percent of total savings
Green Buildings	328,378	59.73%
Renewable Energy	44,295	8.06%

[1] Percentage reductions represent relative contribution to total annual reduction in 2030.

Land Use and Transportation	170,124	30.94%
MSW and Recycling	6,129	1.11%
Water	841	0.15%
Total	**549,766**	**100%**



During each of four 5-year periods between 2010 and 2030, contributions of each to the overall strategy vary, depending upon phase-in schedules associated with numerous individual strategies, specific economics, and other variables. The ultimate goal of 60% green buildings and 30% transportation and land use in meeting emissions reduction targets mimics closely the current division of emission output.

Green Building measures-incorporating weatherization and retrofit actions, as well as behavioral modification related to energy use-create the bulk of early actions- over 80% - in the next five years. Renewable energy development phases in more slowly, in part due to its relatively less favorable economics. Transportation, undoubtedly more difficult to alter than buildings, will rely, in part, on recent federal action to strengthen vehicle fuel standards. To address transportation, Bridgeport must seek collaboration with others, since the vast majority of vehicle miles travelled "in" Bridgeport are actually parts of trips "through" Bridgeport, and developing transit alternatives will, of necessity, reach beyond the city.

Municipal solid waste/recycling and water resources actions currently contribute little to the carbon "spreadsheet", relative to buildings and transportation, but many of the full benefits of resource re-use and water conservation and stewardship are simply not accounted for in carbon analyses, unless full life-cycle approach is taken. Strategies to reduce waste- and water- emissions will have extremely valuable co-benefits, and give equally strong reason for their undertaking.

COMPONENTS OF AN "ACTION-ORIENTED" PLAN

Implementation is the only way to achieve success. All actions will require full community support and participation. Several key elements of this Plan are intended to facilitate implementation of the strategies identified by this plan. These include:

- Identification of concrete 5-year reduction targets for every strategy
- Personalization of action strategies into manageable "blocks" or implementation units– such as 10 households, 10 buildings, or 20 persons-so the strategies may become meaningful on a neighborhood scale, considered the most likely scale for action
- Energy savings linked to each strategy
- Labor in "man-days" linked to many actions to demonstrate broader value of community participation in this EE&C Strategy

EMISSIONS REDUCTION SUMMARY

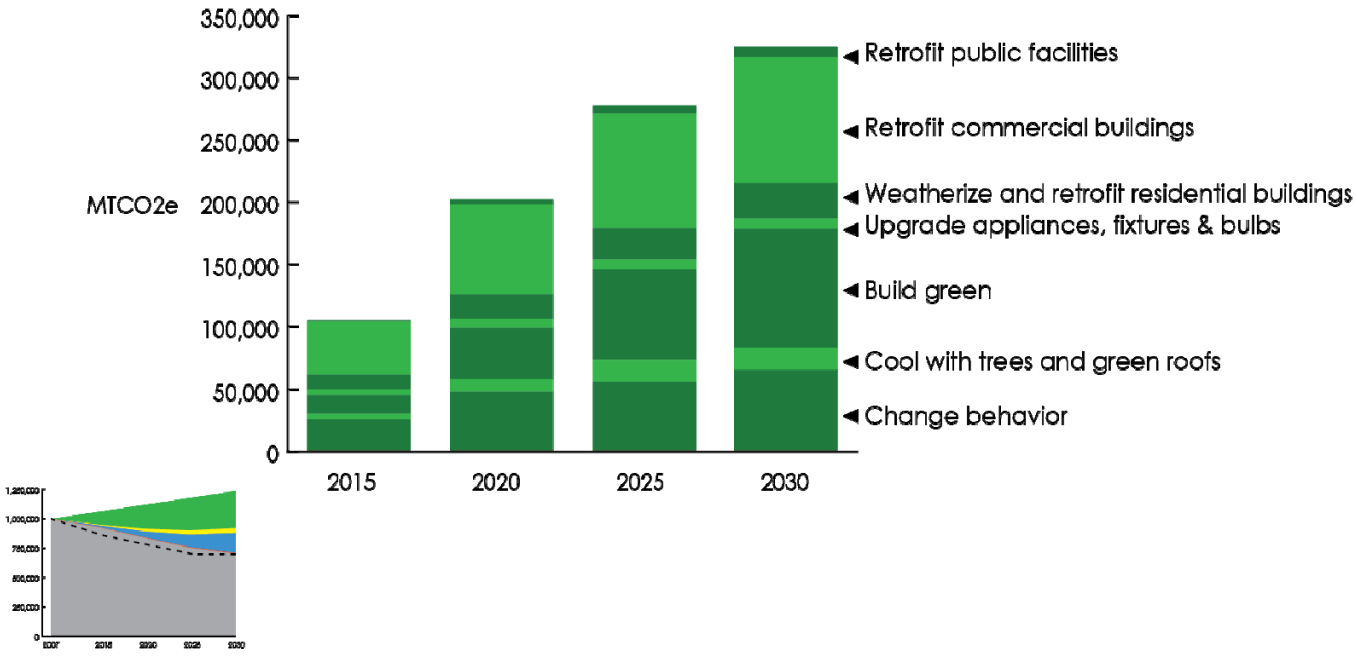
A. Green Buildings Strategy

83.3% of total reduction 2010 to 2015

59.7% of cumulative reduction by 2030

$143 million+ annual energy cost savings created

6,000+ fulltime equivalent work-years



Percentage of total emissions reductions by 2030	**60%**
Jobs created	**6,100 FTEWY**
Annual energy cost savings	**$143,035,000**

- Building weatherization and retrofit are relatively easy and cost effective actions, which provide good returns in terms of reducing fuel costs. This is a strong early action item, which provides 44% of Green Buildings savings by 2030.
- Connecticut's Energy Advisory Board makes all achievable cost effective conservation and efficiency (A-ACE) measures the number one priority in the state's short-term energy management. Connecticut ranks third in the nation for having an outstanding energy efficiency program. Utility and energy supply companies across the board – electricity, natural gas and fuel oil- participate in the State-sponsored program supported by an electric bill fee to all users, and federal recovery funds.
- Green Buildings strategies have the potential to save over $143 million in energy costs annually upon full implementation.
- Weatherizing and retrofitting homes and businesses also offer high potential for jobs. Green Buildings Actions identify opportunity for over 6,000 Full Time Equivalent Work Years associated with implementation. Local entities, including The WorkPlace, Greater Bridgeport Community Enterprises, and Bridgeport Minority and Small Business Center currently provide training programs specific to the jobs

that these actions create. Additional occupational/career training will be needed to meet the high demand.

- The Mayor's Conservation Corps can plan an effective outreach role in continuing to alert residents of the cost savings related to green building measures. Schools and neighborhood groups can "go green" by selling low cost light bulbs as fundraisers.
- Bridgeport's in-place EID has a pivotal role to play, as well, developing additional private funding mechanisms which optimize capacity for Bridgeport to achieve Plan goals. The Connecticut Energy Advisory Board cites expanded funding mechanisms as a critical piece to Connecticut's future energy management plan.
- Redeveloping Bridgeport properties in as green a manner as possible is an important element of this plan, which must be supported by aggressive but realistic building codes and public education.
- Green roofs will have coupled benefits of outdoor temperature moderation, indoor HVAC demand-reduction, greater roof longevity, stormwater management, potential carbon sequestration and positive impact on solar efficiency; the City can take the lead in helping to define a good workable balance of green roof and solar roof development.
- 50,000 trees planted will moderate air quality and temperature.
- Behavioral changes are the easiest of actions proposed in the Green Buildings Strategy, and can provide nearly 30% of the Green Buildings savings.
- Policies related to utility companies and energy supply will impact Bridgeport emissions. Repowering of power plants, for example, may have mixed impact on local emissions, since greater efficiency may be offset by increased generation time.

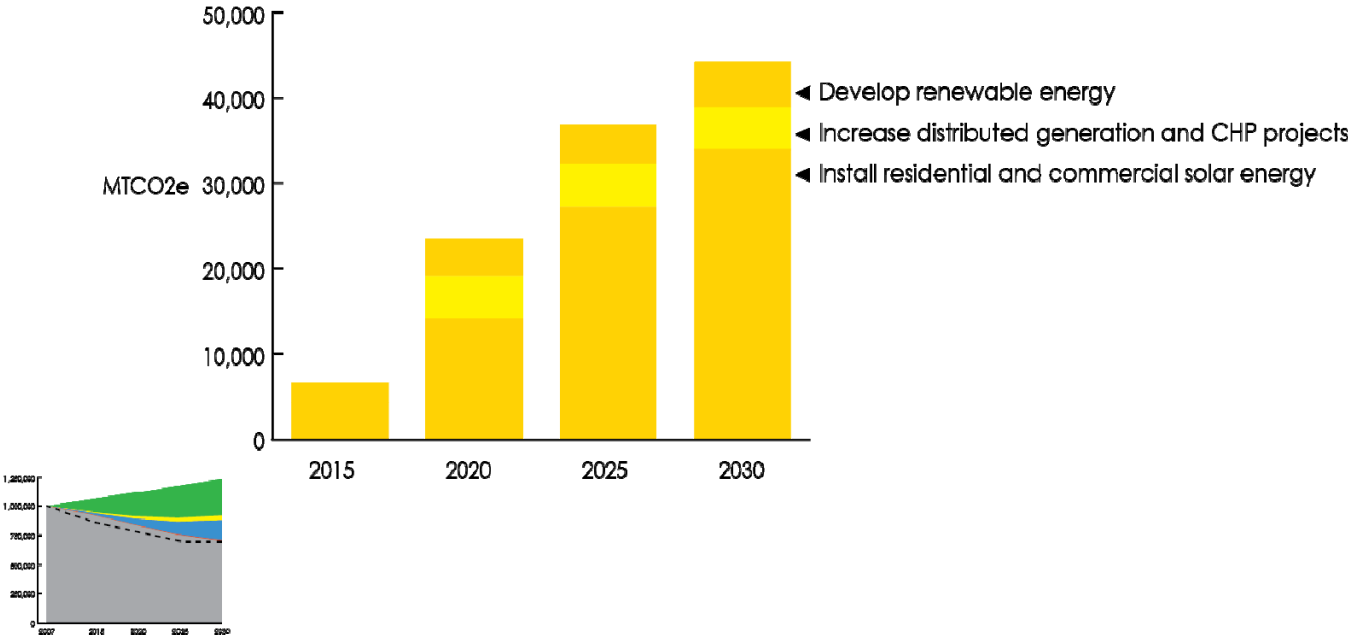
B. Renewable and Clean Energy

5.2% of total reduction 2010 to 2015

8.1% of cumulative reduction by 2030

$20.5 million annual energy cost savings

575+ fulltime equivalent work-years create



Percentage of total emissions reductions by 2030	**8%**
Jobs created	**579 FTEWY**
Annual energy cost savings	**$20,566,000**

Narrative Summary

- Clean and renewable energy strategies assume a steady spot between 5% and 10% of overall Plan reduction savings throughout the plan's twenty-year period.
- Several utility-scale renewable energy projects may be developed in Bridgeport, possibly beginning within 2 or 3 years. These include a 3 MW solar energy park near the closed Seaside Landfill, a 100KW

on-shore windmill on City-owned property near the coast and a biogas retrofit on the City's West Side water treatment facility.

- Connecticut's Energy Advisory Board notes that costs of solar energy are still relatively high compared with weatherization and retrofit opportunities and also notes cost reductions are expected. Ramping up of household and commercial building site solar is delayed for several years under this plan. A City-initiated program, under development, and based on a power purchase agreement with a private entity, may enable earlier establishment of solar capacity, at an acceptable cost. Solar energy installation can prove very beneficial for an end user such as a city for its public and/or educational facilities or business.

- Solar/green roof combinations can have many benefits. Optimizing the mix of these two opportunities is important. Marketing the merits of this mix to commercial property owners will be important.

- Solar thermal costs less than residential solar PV and residents can now benefit from a State funding program in support of its installation. Excellent incentives currently exist for commercial solar thermal, which may be of great benefit to hospitals, daycare centers, hotels, and other similar businesses that do a lot of laundry.

- Bridgeport's southern industrial core should be comprehensively analyzed for development of resource sharing opportunities, as several large players have heat and/or water "waste resources" that can benefit others.

- The Bridgeport EID and Planning and Economic Development Department must work jointly with the State DECD and CDA in identifying more potential for distributed generation, particularly given the power supply systems and resource recovery system near Bridgeport's waterfront.

- The City of Bridgeport can look to expand purchase of "green energy" and may find benefit to working with other municipalities in lower-cost group purchase.

- Connecticut Clean Choice option will help certain residents obtain "green electricity" which can help the City obtain solar PV systems for public facilities. Wind energy, a clean choice option, is viewed by electric suppliers to be the next pivotal piece in regional green generation and supply.

- Although far less than the estimated number of Green Buildings jobs, Renewables can provide employment opportunities in the hundreds of fulltime equivalent work years in Bridgeport.

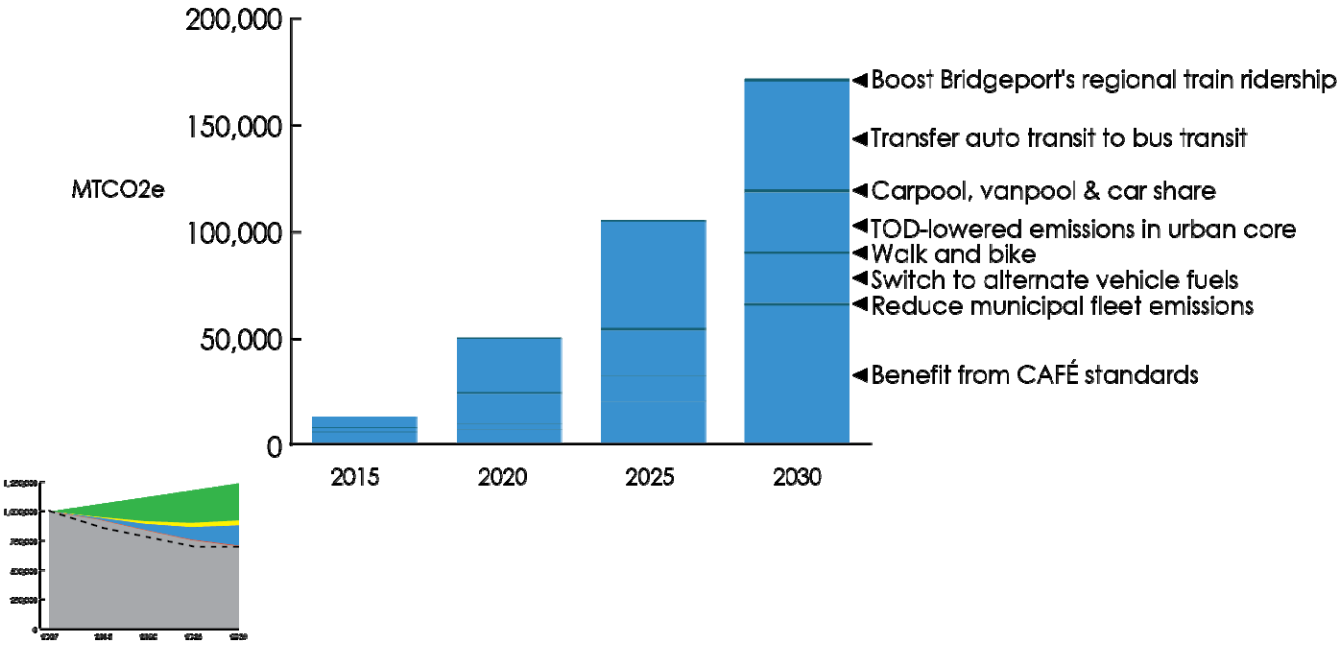
C. Land Use and Transportation

9.4% of total reduction 2010 to 2015

30.9% of cumulative reduction by 2030

$53.3 million annual energy cost savings created

10+ fulltime equivalent work-years



Percentage of total emissions reductions by 2030	**31%**
Annual energy cost savings	**$53,325,000**
More limited employment opportunity	**10 FTEWY**
Annual VMT or fuel equivalent reduction	**714,072,000**
VMT avoidance potential through TOD	**111,064,800**

- Plan action items related to land use and transportation are estimated to have savings potential of $53 million in energy costs a year, upon full implementation. Emissions reduction is the equivalent of roughly 715 million VMT a year.

- Land use and transportation are intertwined in their impact on carbon emissions. Bridgeport's greatest opportunity to effect *regional* emissions reductions is to redevelop. Households, employment centers, cultural and entertainment venues can be located close to the City's urban core and public transit. Recently-revised zoning enables this. Bridgeport emissions will increase from additional in-use structures, but emissions may be avoided if development occurs "in-city" in place of sprawled development.

- 6,000 new households in the urban core will create lower net energy demand and emissions increases than suburban development, owing to more energy-efficient urban form and potential for reduced dependence on automobile usage.

- Along with housing must come support services to decrease reliance on the automobile. These include expanded bus service, shuttle vans to job sites and mechanisms for developing carpools and car share and/or bike share programs.

- An easy opportunity to reduce transportation emissions is to transfer work and non-work trips under 1-mile immediately from automobile VMT to walk or bike VMT. Outreach will be needed to encourage this shift. Schools can play a vital role in bringing students to neighborhood schools in walking or bicycling groups in place of automobiles.

- Flat topography in the City's southern section makes Bridgeport easily-bikeable, and the streets can be made even more bike and pedestrian-friendly through "Complete Streets" development, which is in its nascent stage, under City-direction.

- Beyond Bridgeport's control are the several hundred thousand vehicles that pass through the City on interstate highways daily. Emissions from vehicles passing through the City will be reduced over time as Federal CAFÉ standards prompt more fuel efficient cars and light trucks. Certain reductions will also occur as alternate fueled vehicles begin to enter the market. Connecticut's Electric Vehicles Infrastructure Council (CEVIC) is currently targeting Connecticut for PEV development, although overall market penetration will likely be small.[3]

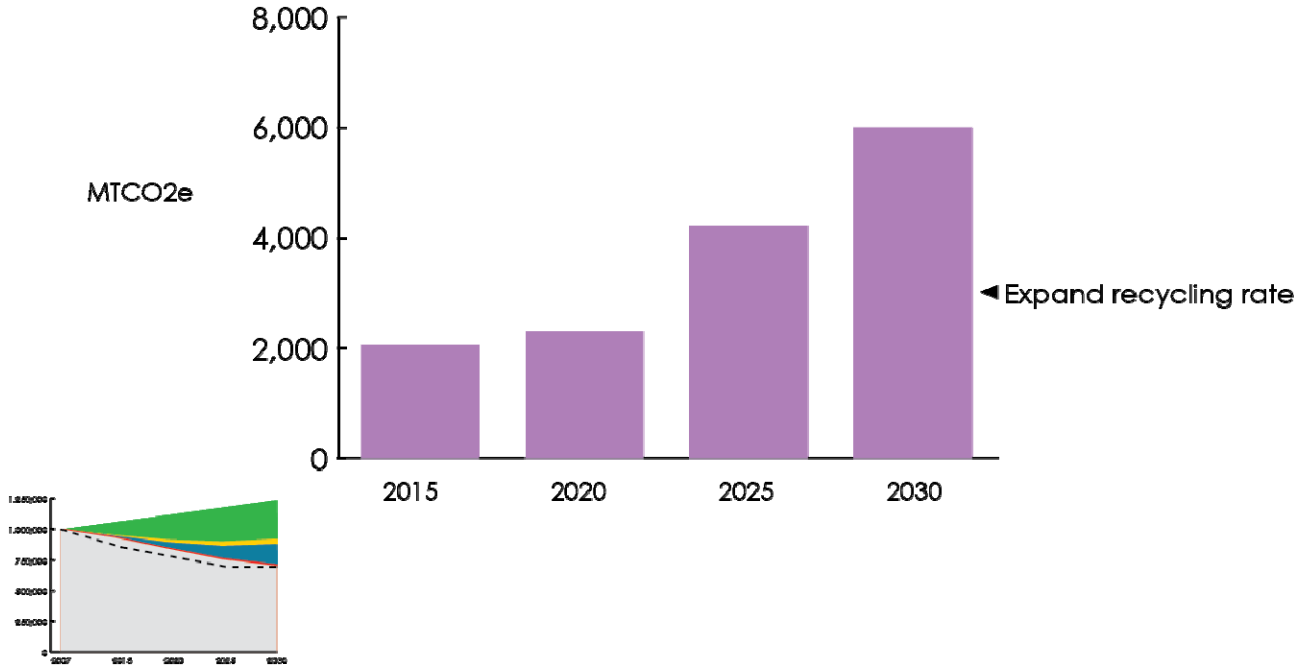
- Also beyond Bridgeport's immediate control is investment in transit. This must continue to take place as part of State and regional smart growth, transport, and economic development, and environmental health strategies. Transit alternatives must be provided to reduce single occupancy vehicle travel, congestion, and poor air quality days, and to enable expanded opportunity to the job market for those unable to afford cars.

- In relation to Green Buildings and Renewable Energy, Transportation and Land Use strategies offer fewer direct job opportunities, but many indirect job opportunities and economic development openings result.

D. Waste **1.6% of total reduction 2010 to 2015**

1.1% of cumulative reduction by 2030

$1.725 million annual tipping fee savings



Percentage of total emissions reductions by 2030	**1%**
Annual tipping fee cost savings	**$1,725,400**

Opportunities for micro-business development

- Bridgeport's incineration of municipal solid waste (MSW) is technically a biomass-fueled operation, in part, and provides electricity-generation, so increased recycling (meaning diversion from incineration) does not show the same carbon reduction impacts as diversion from landfilling would.
- If life-cycle is taken into account, impacts are greater (although they are not quantified by this energy plan). Expanding reuse and recycle is a benefit to keeping many materials "in circulation."
- Increasing recycling *participation* is paramount to diverting tonnage from incineration to recycle and reuse. This plan proposes a fast-tracked and aggressive strategy for creating 80% recycling participation by residents and businesses, quantified and monitored separately from tonnage diverted.
- Residential participation will be bolstered by The Mayor's Conservation Corps and Environmental Justice community group outreach as well as by launch of a pilot recycling incentive program expected to commence within the year.
- The City, BRBC and DSSD will be pivotal to establishing more widespread commercial recycling. A recycling and MSW Management Forum, sponsored by the City of Bridgeport, recently jumpstarted focused attention on an expanded citywide recycling goal and a variety of micro-business opportunities related to solid waste management.
- Composting on several scales will divert significant materials from incineration, although non-commercial composting may result in increased methane release. Larger scale commercial facilities can manage waste and emissions, resulting in a net decrease.
- "Single Stream" or more aggressive system has prompted greater diversion from incineration in many towns, and will likely become a part of Bridgeport's future MSW/Recycling operations.
- Expanded recycling in schools, expected in pilot stage in Fall 2010, will establish a stronger recycling mindset with carry-over benefit to residential participation.
- Employment opportunities linked to MSW and recycling are not identified in this plan, but it is certain that many will evolve. Materials waste management is extremely varied and there is tremendous potential to develop a host of associated micro-businesses. Much of Bridgeport's commercial building space would be well suited to associated start-ups.

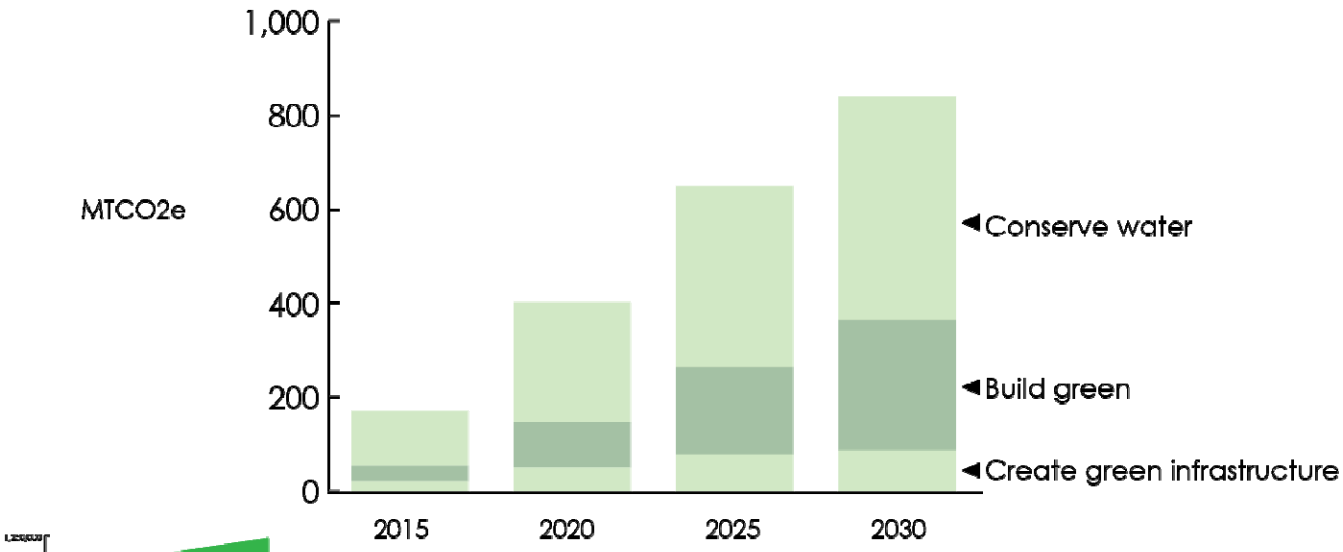
E. Water Resources

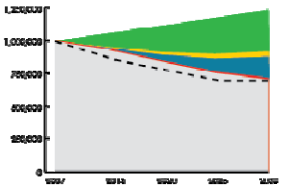
0.13% of total reduction, 2010 to 2015

0.15% of cumulative reduction by 2030

$9.74 million annual energy and water cost savings created

245+ fulltime equivalent work-years





Percentage of total emissions reductions by 2030	**0.2%**
Jobs created	**249 FTEWY**
Annual energy cost savings	**$9,743,000**
Annual water savings and/or treatment diversion	**1,104,000,000 gallons**

- If all items of the Plan are fully implemented, 1.1 billion gallons of water a year (an average exceeding 3 million gallons per day) may be detained or retained from the WPCA system. This will reduce energy demand for treatment and emissions, and provide a valuable buffer to the city stormwater management and flood control capacities.

- Conservation and efficiency, promoted by current water- company and other efficiency programs, can easily expand to provide small cost savings to customers, as well as water control benefit during dry and wet weather. Per customer demand is already on the decline, likely as a result of these programs.[4]

- Careful installation of green infrastructure, including green roofs, rain gardens, and bioswales, can also significantly assist localized water management and flood control. Green roofs will yield strong co-benefits related to building energy, solar PV efficiency and outdoor air quality and temperature.

- Increasingly, cities, including New York City and Philadelphia, report notable benefits to stormwater control, as a result of conservation, efficiency and outdoor green infrastructure. Green roof modeling for Washington D. C. shows significant promise to reduce CSO's, either by reducing total water input to the treatment system, or altering input timing. Bridgeport must draw from these, and other, models.

- Green roof installation and maintenance, as well as rain garden installation, offer job opportunities of close to one thousand work-years, an additional incentive to their implementation.

- New construction and renovations to Bridgeport buildings will certainly achieve water savings, due to improved inherent fixture and system efficiencies.

- The City can promote additional water savings through green building incentives.

- Water "audits" can identify effective ways to reduce water usage in commercial facilities; the EID can assist in creating financing mechanisms for audits and retrofit action.

- City streets and right-of-ways must be viewed as essential elements in water management, and must be employed to significantly temper stormwater flow and benefit water quality in rivers and Long Island Sound.

- The City, as a property owner, has an opportunity to work with WPCA and private landowners, to create water management zones to capture or divert stormwater and provide flood control. Private/public partnership is essential to this effort's success.

As the WPCA works with the State of Connecticut in creating a Long Term Control Plan, green infrastructure inclusion will be essential. Baseline study is needed to quantify potential economic and water quality impact of wide scale implementation. As already noted, action items in this Plan identify means for conserving, retaining, or detaining over 1 Billion gallons of water a year, a small amount compared to the City's whole, but, 3 million gallons/day average being slowed or eliminated from storm sewer systems can prove critical to localized flood control.

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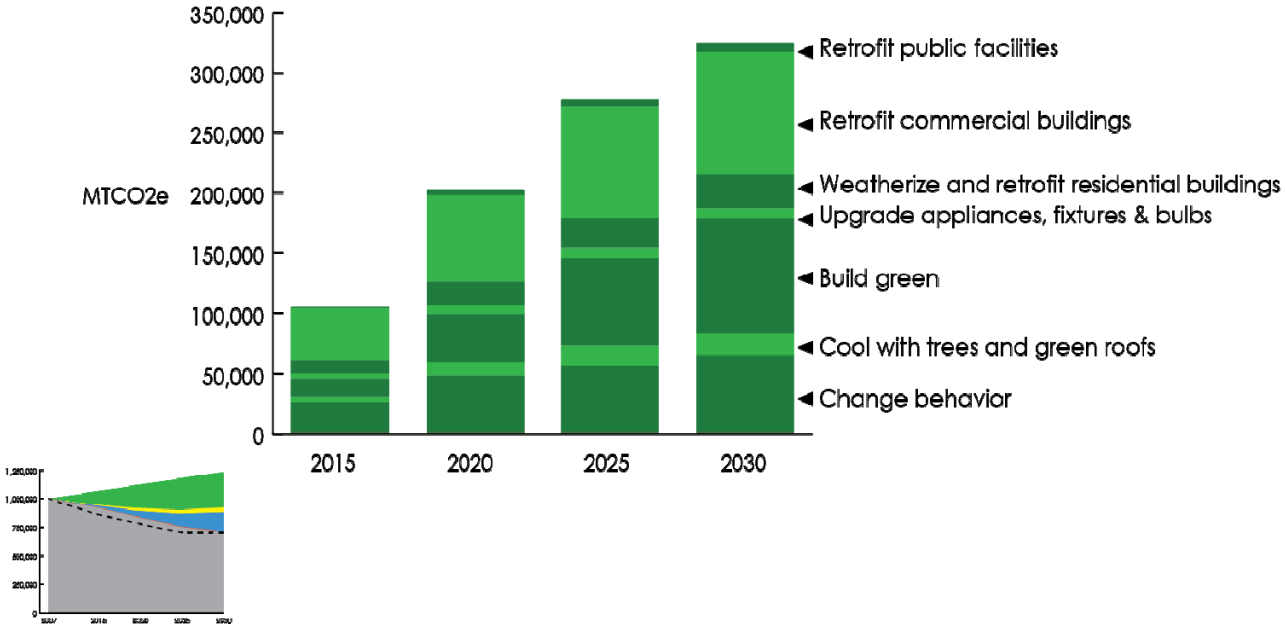
GREEN BUILDING

SUMMARY

83.3% of total reduction, 2010 to 2015

59.7% of cumulative reduction by 2030

Green Buildings		$MTCO_2e$
Action 1	Retrofit Public Facilities	8,012
Action 2	Retrofit Commercial Buildings	101,801
Action 3	Weatherize and Retrofit Residential Buildings	28,301
Action 4	Efficient appliances, fixtures and bulbs	8,533
Action 5	Build Green	93,587
Action 6	Cool with Trees and Green Roofs	18,859
Action 7	Behavioral changes	69,286
Action 8	Utility scale policies and programs with local impact	--
	Annual Emissions Reduction by Full Implementation 2030	**328,378**



SAVINGS (annual by full implementation)	
Electricity	**$88.8 million**
Natural Gas	**$32.6 million**
Light Fuel Oil	**$13.9 million**
Water	**$0.48 million**
GAINS	
Fulltime equivalent work-years	**7,082**

GREEN BUILDINGS

Narrative Summary

- Building weatherization and retrofit are relatively easy and cost effective actions, which provide good returns in terms of reducing fuel costs. This is a strong early action item, which provides 44% of Green Buildings savings by 2030.

- Connecticut's Energy Advisory Board makes all achievable cost effective conservation and efficiency (A-ACE) measures the number one priority in the state's short-term energy management. Connecticut ranks third in the nation for having an outstanding energy efficiency program. Utility and energy supply companies across the board – electricity, natural gas and fuel oil- participate in the State-sponsored program supported by an electric bill fee to all users, and federal recovery funds.

- Green Buildings strategies have the potential to save over $143 million in energy costs annually upon full implementation.

- Weatherizing and retrofitting homes and businesses also offer high potential for jobs. Green Buildings Actions identify opportunity for over 6,000 fulltime equivalent work years (FTEWY) associated with implementation. Local entities, including The WorkPlace, Greater Bridgeport Community Enterprises, and Bridgeport Minority and Small Business Center currently provide training programs specific to the jobs that these actions create. Additional occupational/career training will be needed to meet the high demand.

- The Mayor's Conservation Corps can play an effective outreach role by continuing to alert residents of the cost savings related to green building measures. Schools and neighborhood groups can "go green" by selling low cost light bulbs as fundraisers.

- Bridgeport's in-place EID has a pivotal role to play, as well, developing additional private funding mechanisms which optimize capacity for Bridgeport to achieve Plan goals. The Connecticut Energy Advisory Board cites expanded funding mechanisms as a critical piece to Connecticut's future energy management plan.

- Redeveloping Bridgeport properties in as green a manner as possible is an important element of this plan, which must be supported by aggressive but realistic building codes and public education.

- Green roofs will have coupled benefits of outdoor temperature moderation, indoor HVAC demand-reduction, greater roof longevity, stormwater management, potential carbon sequestration and positive impact on solar efficiency; the City can take the lead in helping to define a good workable balance of green roof and solar roof development.

- 50,000 trees planted will benefit air quality and reduce energy demand by moderating temperature

- Behavioral changes are the easiest of actions proposed in the Green Buildings Strategy, and can provide nearly 30% of the Green Buildings savings.

- Policies related to utility companies and energy supply will impact Bridgeport emissions. Repowering of power plants, for example, may have mixed impact on local emissions, since greater efficiency may be offset by increased generation time.

Green buildings

ACTION 1	RETROFIT PUBLIC FACILITIES

- ***Sub item 1.1 - Reduce Public Facilities emissions***
  Goal: Achieve 30% reduction in 2007 public facilities emissions by 2030.

Annual Savings Potential by 2030 **2,234 $MTCO_2e$**

The 2007 energy and emissions at combined Public Facilities[5] were as follows:

Public Facilities total energy use is 95,192,048 kBtu	
Indirect emissions (from electricity)	4,164 $MTCO_2e$
Direct emissions (from natural gas)	3,281 $MTCO_2e$
30% savings indirect emissions would equal	1,250 $MTCO_2e$
30% savings direct emissions would equal	984 $MTCO_2e$
Total emissions savings would equal	2,234 $MTCO_2e$

Electricity savings potential[6] is 3,009,705 kWh

Natural gas savings potential [7] is 17,217 thousand cf natural gas

Implementation Summary

This action can be accomplished as follows:

Implementation units:	5% emissions reduction
Implementation units needed:	6

Implementation Schedule to achieve 30% reduction in 2007 emissions

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	5%	10%	10%	5%	30%
No. of units	1	2	2	1	6
$MTCO_2e$	372	745	745	372	2,234

Annual Energy and Utility Cost Savings upon Full Implementation

Upon full implementation, this action may offer the following savings per year.[8]

Electricity	3,009,705 kWh	$722,300
Natural Gas	17,217 thousand cf	$168,900

Additional Considerations

Energy Star benchmarking using the EPA Portfolio Manager tool has already been completed by the City for all municipal and BOE facilities. This enables the City to immediately prioritize retrofits, project longer term funding needs, and incorporate retrofit needs into funding requests for State and/or Federal funds.

Continued construction of any new facilities shall adhere to more efficient energy standards.

Building retrofits offer potential cost savings in Bridgeport City operating budget due to associated reductions in utility costs.

Continued prioritization of facilities consolidation and excess property disposal supports reduction in municipal sector building emissions.

Cost savings will result from lower utility costs in retrofitted buildings. Energy performance contracting, in conjunction with federal and state grant monies, will reduce initial outlay of City funds.

The Connecticut Energy Advisory Board, in 2010, established energy efficiency and conservation as the top priority for energy management in Connecticut. It recommends implementation of all achievable cost effective measures.

Retrofit of municipal buildings helps sustain employment in the building and related trades. Employment potential has not been quantified for this action item.

- ***Sub item 1.2 - Reduce Public School emissions***
  Goal: Achieve 30% reduction in 2007 Public School emissions by 2030.

Annual Savings Potential by 2030 **5,778 $MTCO_2e$**

The 2007 energy and emissions at Bridgeport public schools[9] were as follows:

Schools total energy use is 247,315,910 kBtu	
Indirect emissions (from electricity)	8,887 $MTCO_2e$
Direct emissions (from natural gas)	10,371 $MTCO_2e$
30% savings indirect emissions would be	2,666 $MTCO_2e$
30% savings direct emissions would be	3,112 $MTCO_2e$
Total emissions savings would be	5,778 $MTCO_2e$

Electricity savings potential[10] is 6,422,350 kWh
Natural gas savings potential[11] is 54,422 thousand cf

Implementation Summary
This action can be accomplished as follows:

Implementation units:	5% emissions reduction
Implementation units needed:	6

Implementation Schedule to achieve 30% reduction in 2007 emissions

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	5%	10%	10%	5%	30%
No. of units	1	2	2	1	6

$MTCO_2e$	963	1926	1926	963	5,778

Annual Energy and Utility Cost Savings upon Full Implementation

Upon full implementation, this action may offer the following savings per year.[12]

Electricity	6,422,350 kWh	$1,541,400
Natural Gas	54,422 thousand cf	$ 533,900

Additional considerations

Energy Star benchmarking using the EPA Portfolio Manager tool has already been completed by the City for all municipal and BOE facilities. This enables the City to immediately prioritize retrofits and incorporate retrofit needs into annual funding request to State for school facilities and longer term funding planning.

Continued construction of new, more energy-efficient facilities shall continue according to the long term school facilities plan.

Cost savings will result from lower utility costs in retrofitted buildings. Energy performance contracting, in conjunction with federal and state grant monies, will reduce initial outlay of City funds.

The Connecticut Energy Advisory Board, in 2010, established energy efficiency and conservation as the top priority for energy management in Connecticut. It recommends implementation of all achievable cost effective measures.

Retrofit of municipal buildings helps sustain employment in the building and related trades. Employment potential has not been quantified for this action item.

ACTION 2 RETROFIT COMMERCIAL BUILDINGS

- ***Sub Action 2.1 - UI Small Business Energy Advantage or similar program for 1,000 small businesses***
  Goal: achieve 25% reduction in 2007 commercial building emissions[13] through utility or other weatherization and retrofit programs.

Annual Savings Potential by 2030 **9,679 $MTCO_2e$**

Per building average annual savings potential

23,314 kWh[14] 10 $MTCO_2e$[15]

Implementation Summary

This action assumes program implementation in small businesses at 1,000 project sites. This action can be accomplished as follows:

Implementation unit: 10 project sites
Implementation units needed: 100

Implementation Schedule

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0.4	0.3	0.2	0.1	1.00
No. units	40	30	20	10	100
$MTCO_2e$	3,871	2,904	1,936	968	9,679

Annual Energy and Utility Cost Savings upon Full Implementation

Upon full implementation, this action, in its entirety, may offer the following savings per year.[16]

Electricity	23,314,000 kWh	$5,595,000

An average business might save $5,595 in electrical costs per year from taking this action, although savings may be matched against cost of implementation.

Additional considerations

The UI Small Business Energy Advantage program is an "in-place" program, funded through a State Conservation and Efficiency Fund, which provides cost-effective conservation and load management services for small business customers. The program includes energy assessments and installation of measures with no up-front cost to the customer. The program includes measures such as installation of high-performance fixture retrofits, occupancy sensors, cfl's, LED strips, door heater controls, and/or fan motor controls.

Implementing these measures can provide annual savings on utility bills.

The Connecticut Energy Advisory Board, in 2010, established energy efficiency and conservation as the top priority for energy management in Connecticut. It recommends implementation of all achievable cost effective measures.

The CEAB also prioritizes creation of additional financing programs to supplement the utility-supported programs, which are currently funded by a small charge on all electric utility bills.[17] Bridgeport's electric utility, UI, already offers interest free loans on the electric bill financing for measures installed through this Small Business Program. Most relate to lighting projects and refrigeration controls.

Bridgeport's in-place Energy Improvement District (EID) may play a pivotal role in establishing additional financing programs to expand commercial efficiency and conservation load management program participation, and supplement financing programs which already exist through the electric and other utility companies.

The Bridgeport Regional Business Council (BRBC) and Mayor's Conservation Corps can provide critical support roles to the utility companies by expanding outreach to increase participation in this commercial energy-saving program.

Measures carried out under the UI Small Business Energy Advantage or similar program are estimated to create job potential for 91 fulltime equivalent work years.[18]

- ***Sub Action 2.2 - UI/SCG Energy Opportunities or similar program for 1,000 larger project sites***
  Goal: achieve 25% reduction in 2007 commercial building emissions using existing utility energy conservation programs at existing commercial buildings.

Annual Savings Potential by 2030 **89,088 $MTCO_2e$**

Per building average annual savings potential

97,478 kWh[19]	40 $MTCO_2e$[20]
850.4 thousand cf natural gas[21]	49 $MTCO_2e$[22]

Implementation Summary

This action assumes program implementation in 1,000 commercial building project sites. This action can be accomplished as follows:

Implementation unit:	10 project sites
Implementation units needed:	100

Implementation Schedule

	2010-15	2015-20	020-25	2025-30	2010 to 2030 Total
Percent	0.4	0.3	0.2	0.1	1.00
No. units	40	30	20	10	100
$MTCO_2e$	35,635	26,727	17,818	8,909	89,088

Annual Energy and Cost Savings upon Full Implementation

Upon full implementation, this action, in its entirety, may offer the following savings per year.[23]

Electricity	97,478,000 kWh	$23,394,700
Natural Gas	850,400 thousand cf	$7,806,700

Implementing these measures can provide annual savings on utility bills. Annual energy-related savings per completed building are estimated at over $30,000, although savings may be matched against cost of implementation.

Additional Considerations

The UI/SCG Energy Opportunities program is an "in-place" program, funded through a State Conservation and Efficiency Fund, and sometimes supplemented by utility-financing, which provides cost-effective conservation and load management services for larger commercial customers.

The Connecticut Energy Advisory Board, in 2010, established energy efficiency and conservation as the top priority for energy management in Connecticut. It recommends implementation of all achievable cost effective measures.

The CEAB also prioritizes creation of additional financing programs to supplement the utility-supported programs, which are currently funded by a small charge on all electric utility bills.[24] *Bridgeport's electric utility, UI, currently partners with a vendor to* offer *reduced interest loans (as low as 7% designed to provide positive cash flow from energy savings) for amounts up to $100,000.*

Bridgeport's in-place Energy Improvement District (EID) may play a pivotal role in establishing additional financing programs to expand commercial efficiency and conservation load management program participation, and supplement financing programs which already exist through the electric and other utility companies.

The Bridgeport Regional Business Council (BRBC) and Mayor's Conservation Corps may play a pivotal role in assisting the utility companies by expanding outreach to increase participation in this commercial energy-saving program.

Measures carried out under the UI/SCG Energy Opportunities or similar program are estimated to create job potential for 2,912 fulltime equivalent work years.[25]

- ***Sub Action 2.3 - BHA reductions at 2,500 units, underway***
  Goal: Achieve 20% to 25% reduction in emissions at 2,500 BHA units.

Annual Savings Potential by 2030 **3,034 $MTCO_2e$**

Project savings potential[26]

1,561,529 kWh	704 $MTCO_2e$
40,124 thousand cf	2,294 $MTCO_2e$
95,965,400 gallons	

Implementation Summary

Building retrofits are underway at almost 2,500 housing units. This plan assumes complete program implementation by 2015.

Implementation unit:	1 project
Implementation units needed:	1

Implementation Schedule

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	100	complete	complete	complete	
No. units	1				
$MTCO_2e$	3,034				3,034

Annual Energy and Cost Savings upon Full Implementation

Upon full implementation, this action may offer the following savings per year.[27]

Electricity	1,561,529 kWh	$374,800
Natural Gas	40,124 thousand cf	$393,600
Water	95,965,408 gallons	$479,800

Combined annual savings for this completed measure is estimated to be greater than $1.2Million, although savings may be matched against cost of implementation.

Additional Considerations

The BHA has taken a lead in retrofitting its multi-unit residential buildings.

This provides an excellent model of successful energy auditing, utility program optimization and performance contracting. This retrofit model should be duplicated in other larger residential complexes. Outreach must specifically target these other complexes to ensure building owners are made aware of the savings potential from retrofits and no-risk opportunity that energy performance contracting and utility rebate and low- or no-interest loan programs offer.

The EID, in conjunction with the Bridgeport Regional Business Council, a partner to BGreen 2020, could take a lead in outreach related to additional multi-unit residential building retrofits and the opportunity for performance contracting and loan and rebate benefit.

Labor estimates from implementation of this strategy were not quantified for this plan.

ACTION 3 WEATHERIZE AND RETROFIT RESIDENTIAL BUILDINGS

- ***Sub Action 3.1 - Home Energy Solutions or similar program in 25% of all households (11,885 households) by 2030[28]***

Goal: achieve 10% reduction in existing household emissions through utility or other weatherization and energy-savings programs.

Annual Savings Potential by 2030 **8,631 $MTCO_2e$**

Per household savings potential

1,070	kWh[29]	0.44 $MTCO_2e$[30]
6.5	thousand cf [31]	0.52 $MTCO_2e$[32]
0.05625	thousand gallons fuel oil[33]	0.03 $MTCO_2e$[34]
Total emissions savings per household		0.73 $MTCO_2e$

Implementation Summary

This action assumes program implementation in 25% of existing households (11,885 households) by 2030. This action can be accomplished as follows:

Implementation unit:	10 households
Implementation units needed:	1,189

Implementation Schedule

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0.4	0.3	0.2	0.1	1.0
No. units	475	357	238	119	1,189
$MTCO_2e$	3,452	2,589	1,726	863	8,631

Annual Energy and Cost Savings upon Full Implementation

Upon full implementation, this action may offer the following savings per year.[35]

Electricity	12,716,950 kWh	$3,052,000
Natural Gas	77,253 thousand cf	$1,144,100
Light fuel oil	668 thousand gallons	$1,771,600

This action may result in average annual savings per household of approximately $500. The program cost to participants is $75, or a fee up to $300 for oil customers (depending on federal funding availability to offset the fee). The value of services in return often exceeds $700.

Additional Considerations

The Home Energy Solutions program includes several simple but effective measures during initial implementation. These include caulking, installation of attic insulation if needed and accessible, weather-stripping around exterior doors, installation of faucet aerators, low-flow showerheads, pipe insulation close to boilers, and installation of cfl's. Additional, more intensive retrofits may be added.

Weatherization is a relatively inexpensive measure, which has potential to quickly achieve significant energy and emissions savings.

The Connecticut Energy Advisory Board, in 2010, established energy efficiency and conservation as the top priority for energy management in Connecticut. It recommends implementation of all achievable cost effective measures. The Home Energy Solutions program supports this priority.

The CEAB also recommends creation of additional financing programs to supplement the utility-supported programs, which are currently funded by a small charge on all electric utility bills.[36] Bridgeport's electric utility, UI, currently offers loans through a vendor for between $2,500 and $20,000,with interest rates as low as 0%, for a variety of efficiency measures. To receive 0% financing, comprehensive work, such as new air conditioning and insulation, must be done.

The EID may play a pivotal role in establishing additional financing programs to expand residential weatherization participation.

The Mayor's Conservation Corps may also play a pivotal role by expanding outreach to increase participation in residential energy-saving programs. Particular attention must be paid by the Conservation Corps and utilities to establish a successful mechanism for engaging non-resident landlords in program participation.

Measures carried out under the Home Energy Solutions, or similar program, are estimated to create job potential for 48 fulltime equivalent work years.[37]

- ***Sub Action 3.2 - "Income Eligible" or similar program at 25% of all household (11,885[38] households) by 2030***
  Goal: achieve 10% reduction in existing household emissions through utility or other weatherization and energy-savings programs.

Annual Savings Potential	**16,644 $MTCO_2e$**

Per household savings potential

1,031 kWh[39]	0.43 $MTCO_2e$[40]
12.4 thousand cf [41]	0.71 $MTCO_2e$[42]
0.05625 thousand gallons fuel oil[43]	0.53 $MTCO_2e$[44]
Total emissions savings per household	1.40 $MTCO_2e$

Implementation Summary

This action assumes program implementation in 25% of existing households (11,885 households). This action can be accomplished as follows:

Implementation unit: 10 households

Implementation units needed: 1,189

Implementation Schedule

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0.4	0.3	0.2	0.1	1.0
No. units	475	357	238	119	1,189
$MTCO_2e$	6,658	4,993	3,329	1,664	16,644

Upon full implementation, this action may offer the following savings per year.[45]

Electricity	12,253,435 kWh	$2,940,800
Natural Gas	147,374 thousand cf	$2,182,600
Light fuel oil	669 thousand gallons	$1,771,600

This action may result in average annual savings per household of approximately $600.

Additional Considerations

The Income Eligible program includes several simple but effective measures, which are done at no cost to eligible residents, and are supported by an added fee to all electric utility ratepayers. These measures include caulking, installation of attic insulation if needed and accessible, weather-stripping around exterior doors, installation of faucet aerators, low-flow showerheads and installation of cfl's. Services often exceed $700 per household.

The Connecticut Energy Advisory Board, in 2010, established energy efficiency and conservation as the top priority for energy management in Connecticut. It recommends implementation of all achievable cost effective measures. This Income Eligible program supports this goal.

Weatherization is a relatively inexpensive measure, which has potential to achieve valuable energy and emissions savings.

Low-income families reportedly spend up to 25% of their income on energy costs, making energy efficiency and retrofits essential.[46]

The CEAB also recommends creation of additional financing programs to supplement the utility-supported programs, which are currently funded by a small charge on all electric utility bills[47]. Bridgeport's electric utility, UI, currently offers loans through a vendor for between $2,500 and $20,000,with interest rates as low as 0%, for a variety of efficiency measures. To receive 0% financing, comprehensive work, such as new air conditioning and insulation, must be done.

The EID may play a pivotal role in establishing additional financing programs to expand residential weatherization participation.

The Mayor's Conservation Corps may also play a pivotal role by expanding outreach to increase participation in residential energy-saving programs. Particular attention must be paid by the Conservation Corps and utilities to establish a successful mechanism for engaging non-resident landlords in program participation, since many income-eligible customers may also rent, rather than own.

Measures carried out under the Home Energy Solutions, or similar program, are estimated to create job potential for 48 fulltime equivalent work years.[48]

- ***Sub Action 3.3 - Insulate residential buildings***
  Goal: Achieve 10% reduction in existing single building residential emissions by installing ceiling insulation.[49]

Annual Savings Potential by 2030 **1,585 $MTCO_2e$**

Per building savings potential

829.92 kWh (if electric heated)[50]	0.344 $MTCO_2e$[51]
3.724 thousand cf (if gas heated)[52]	0.213 $MTCO_2e$[53]
0.0266 thousand gallons fuel oil (if oil heated)[54]	0.249 $MTCO_2e$[55]
Total emissions savings per building[56]	0.231 $MTCO_2e$

Implementation Summary

This action assumes program implementation in 6,860 residential buildings[57] (not households) by 2030. This action can be accomplished as follows:

Implementation unit:	10 buildings
Implementation units needed:	686

Implementation Schedule

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0.4	0.3	0.2	0.1	1.0
No. units	475	357	238	119	1,189
$MTCO_2e$	634	475	317	158	1,585

Upon full implementation, this action may offer the following savings per year.[58]

Natural Gas	12,773.32 thousand cf	$189,200
Light fuel oil	91.24 thousand gallons	$511,300

This action may result in average annual savings per building of approximately $75.

Additional Considerations

This home insulation program is considered separate and apart from other utility company programs, such as the Home Energy Solutions program and Income Eligible program, which also may include ceiling insulation if needed and accessible.

The Connecticut Energy Advisory Board, in 2010, established energy efficiency and conservation as the top priority for energy management in Connecticut. It recommends implementation of all achievable cost effective measures.

Weatherization is a relatively inexpensive measure, which has potential to achieve significant energy and emissions savings.

The CEAB also recommends creation of additional financing programs to supplement the utility-supported programs, which are currently funded by a small charge on all electric utility bills.[59]. Bridgeport's electric utility, UI, currently offers loans through a vendor for between $2,500 and $20,000,with interest rates as low as 0%, for a variety of efficiency measures. To receive 0% financing, comprehensive work, such as new air conditioning and insulation, must be done.

The EID may play a pivotal role in establishing additional financing programs to expand residential weatherization participation.

The Mayor's Conservation Corps may also play a pivotal role by expanding outreach to increase participation in residential energy-saving programs. Particular attention must be paid by the Conservation Corps and utilities to establish a successful mechanism for engaging non-resident landlords in program participation.

Measures carried out under the ceiling insulation program, are estimated to create job potential for 55 fulltime equivalent work years[60].

Several training programs already exist in Bridgeport to prepare residents for employment related to this type of action. These include the Bridgeport Small and Minority Business Center training for building retrofits, the WorkPlace's "Green Up" program, which links with numerous other existing training programs, and the Greater Bridgeport Community Enterprises (Green Team) programs.

- ***Sub Action 3.4 - DIY Weatherization***
  Goal: achieve 10% reduction in household emissions through do-it-yourself weatherization measures in 5% of existing households.

Annual Savings Potential by 2030 **1,440 $MTCO_2e$**

Per household savings potential

695 kWh[61]	0.29 $MTCO_2e$[62]
3.57 thousand cf natural gas	0.20 $MTCO_2e$
0.0098 thousand gallons fuel oil	0.10 $MTCO_2e$
Total emissions savings per building	0.60 $MTCO_2e$

Implementation Summary

This action assumes program implementation in 2,420 households by 2030, and assumes certain homeowners will perform insulation procedures on their own, apart from available utility programs. This action can be accomplished as follows:

Implementation unit:	10 buildings
Implementation units needed:	242

Implementation Schedule

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0.4	0.3	0.2	0.1	1.0
No. units	97	73	48	24	242
$MTCO_2e$	576	432	288	144	1,440

Upon full implementation, this action may offer the following savings per year.[63]

Electricity	1,681,858 kWh	$403,600
Natural Gas	8,642 thousand cf	$128,000
Light fuel oil	23.63 thousand gallons	$62,600

This action may result in average annual savings per household of approximately $240.

Additional Considerations

Weatherization is a relatively inexpensive measure, which has potential to achieve significant energy and emissions savings. This strategy assumes certain residents or building owners will pursue building insulation on their own, separate from utility programs. The cost of this measure will be the cost of insulation alone, not labor.

The Connecticut Energy Advisory Board, in 2010, established energy efficiency and conservation as the top priority for energy management in Connecticut. It recommends implementation of all achievable cost effective measures.

The CEAB also recommends creation of additional financing programs to supplement the utility-supported programs, which are currently funded by a small charge on all electric utility bills.

The EID may play a pivotal role in establishing additional financing programs to expand residential weatherization participation.

The Mayor's Conservation Corps may also play a pivotal role by expanding outreach to increase participation in residential energy-saving programs. Particular attention must be paid by the Conservation Corps and utilities to establish a successful mechanism for engaging non-resident landlords in program participation.

This action item involves self-installation of insulation and creates only indirect employment opportunities.

ACTION 4 EFFICIENT APPLIANCES, FIXTURES AND BULBS

- ***Sub Action 4.1 - Install 4 energy efficient light bulbs in all households = 47,543 households = 190,172 bulbs initial install***

  Goal: Conserve residential energy through a switch to 75% more efficient light bulbs.

Annual Savings Potential by 2030 **4,843 $MTCO_2e$**

Per household savings potential

Electricity 245.3652 kWh[64] 0.1019 $MTCO_2e$[65]

Implementation Summary

This action assumes installation of 4 cfl bulbs in 47,543 existing households.[66]

This action can be accomplished as follows:

Implementation unit: 10 households

Implementation units needed: 4,745

Implementation Schedule

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0.4	0.3	0.2	0.1	1.0
No. units	2,853	1,902	0	0	4,745
$MTCO_2e$	2906	1,937	0	0	4,843

Upon full implementation, this action may offer the following savings per year.[67]

Electricity 11,665,398 kWh $2,799,700

This action may result in average annual savings per household of approximately $60, which is partially offset by the higher initial cost of the bulbs.

Additional Considerations

During 2010, a light bulb sales program is being offered as a fund-raising opportunity for schools and other community groups through the Connecticut Clean Energy Fund. Bulk quantity bulbs are available for less than market value, which enables profits to be placed toward organizational fundraising goals.[68] In addition, nontraditional bulb distribution opportunities may exist through routine outreach programs of such entities as Meals on Wheels, Fire Department inspections, Police Department outreach, and Building Inspector inspections.

Lighting represents approximately 9% of home electric use.[69] This is an easy opportunity to save energy, money and emissions.

This action assumes installation of light bulbs separate and distinct from bulb installation associated with utility programs cited in other Energy Plan Action items 3.1 Home Energy Solutions and 3.2 Income Eligible, which both include bulb installation.

Utility companies note that general service bulbs have become increasingly prevalent in households but that specialty light bulb use has lagged. Utility programs plan to place more emphasis on expanding installation of specialty bulbs.[70]

This action item involves self-installation of light bulbs and creates only indirect employment opportunities.

- ***Sub Action 4.2 - Refrigerator Trade-Ins***
  Goal: Trade in inefficient refrigerators and freezers in 5% of all households.

Annual Savings Potential by 2030 **18 $MTCO_2e$**

Per household savings potential

24 kWh[71] 0.01 $MTCO_2e$[72]

Implementation Summary

This action assumes refrigerator or freezer trade-in in 5% of Bridgeport households, which equals 2,378 households. It assumes refrigerator trade-ins will account for 75% of this total, which equals 1,783 inefficient refrigerators.

This action can be accomplished as follows:

Implementation unit:	10 appliances
Implementation units needed:	178

Implementation Schedule

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0.4	0.3	0.2	0.1	1.0
No. units	71	53	36	18	178
$MTCO_2e$	7	5	4	2	18

Upon full implementation, this action may offer the following savings per year.[73]

Electricity	42,792	kWh	$10,200

This action may result in average annual savings per household of approximately $6[74].

Additional Considerations

Air conditioners and refrigerators make up approximately 30% of residential electric usage in the United States.[75] Refrigerator trade-in is an easy opportunity to save energy and emissions. Although annual energy and cost savings are expected from new refrigerator operation, a new Energy Star refrigerator is estimated to cost $400 (somewhat size-dependent).[76]

An effective in-place utility program provides for refrigerator replacement, free of charge, to income-eligible residents. For the consumer, this program negates all costs of refrigerator replacement, including the incremental cost of upgrading to an Energy Star appliance.

Within the twenty-year time frame of this Energy Plan, it is expected that greater than 5% of Bridgeport households will replace refrigerators outside of the existing utility program, through normal appliance retirement, and many will be Energy Star. This Energy Plan action item only includes refrigerator trade-in through the existing utility-run program. Additional emissions savings are anticipated from natural trade-in of non-program appliances, but any such savings are not counted in this Bridgeport Energy Plan.

Measures carried out under the refrigerator replacement program, are estimated to create job potential for 4 fulltime equivalent work-years.[77]

- ***Sub Action 4.3 - Freezer Trade-Ins***
  Goal: Trade in inefficient refrigerators and freezers from 5% of all households.

Annual Savings Potential by 2030 **9 $MTCO_2e$**

Per household savings potential

36 kWh[78] 0.015 $MTCO_2e$[79]

Implementation Summary

This action assumes refrigerator or freezer trade-in in 5% of Bridgeport households, which equals 2,378 households. It assumes freezer trade-ins will account for 25% of this total, which equals 594 inefficient refrigerators.

This action can be accomplished as follows:
Implementation unit: 10 freezers
Implementation units needed: 59

Implementation Schedule

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0.4	0.3	0.2	0.1	1.0
No. units	24	18	12	6	59
$MTCO_2e$	4	3	2	1	9[80]

Upon full implementation, this action may offer the following savings per year.[81]

Electricity	21,384 kWh	$5,132

This action may result in average annual utility savings per household of approximately $9.

Additional Considerations

Freezer trade-in is an easy opportunity to save energy and emissions. Although annual energy and cost savings are expected from new freezer operation, a new Energy Star freezer is estimated to cost several hundred dollars at minimum (somewhat size-dependent).

An effective in-place utility program provides for freezer replacement, free of charge, to income-eligible residents. For the consumer, this program negates all costs of freezer replacement, including the incremental cost of upgrading to an Energy Star appliance.

Within the twenty-year time frame of this Energy Plan, it is expected that greater than 5% of Bridgeport households will replace freezers outside of the existing utility program, through normal appliance retirement, and many will be Energy Star. This Energy Plan action item only includes freezer trade-in through the existing utility-run program. Additional emissions savings are anticipated from natural trade-in of non-program appliances, but any such savings are not counted in this Bridgeport Energy Plan.

Measures carried out under the freezer replacement program, are estimated to create job potential for1 fulltime equivalent work-year.[82]

- ***Sub Action 4.4 - Air conditioner Trade-Ins***
  Goal: Trade in inefficient air conditioners in 5% of all households.

Annual Savings Potential by 2030 **76 $MTCO_2e$**

Per household savings potential

77 kWh[83] 0.03 $MTCO_2e$[84]

Implementation Summary

This action assumes air conditioner trade-in in 5% of Bridgeport households, which equals 2,378 households.

This action can be accomplished as follows:

Implementation unit: 10 appliances

Implementation units needed: 237

Implementation Schedule

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0.4	0.3	0.2	0.1	1.0
No. units	95	71	47	24	237
$MTCO_2e$	30	23	15	8	76

Upon full implementation, this action may offer the following savings per year.[85]

Electricity 183,356 kWh $44,000

This action may result in average annual utility savings per household of approximately $19.[86]

Additional Considerations

Air conditioners and refrigerators make up approximately 30% of residential electric usage in the United States.[87] Room air conditioner trade-in is an easy opportunity to save energy and emissions. Although annual energy and cost savings are expected from new air conditioner operation, a new Energy Star air conditioner is estimated to cost $150 (somewhat size-dependent).[88]

An effective in-place utility program provides for air conditioner replacement, free of charge, to income-eligible residents. For the consumer, this program negates all costs of air conditioner replacement, including the incremental cost of upgrading to an Energy Star appliance.

Within the twenty-year time frame of this Energy Plan, it is expected that greater than 5% of Bridgeport households will replace air conditioners outside of the existing utility program, through normal appliance retirement, and many will be Energy Star. This Energy Plan action item only includes air conditioner trade-in through the existing utility-run program. Additional emissions savings are anticipated from natural trade-in of non-program appliances, but any such savings are not counted in this Bridgeport Energy Plan.

Measures carried out under the air conditioner replacement program, are estimated to create job potential for 7 fulltime equivalent work-years.

- ***Sub Action 4.5 - Clothes washer trade-ins***

  Goal: Trade in inefficient clothes washers from 30% of all households.

Annual Savings Potential by 2030 **134 $MTCO_2e$**

Per household savings potential

17 kWh[89]	0.0071 $MTCO_2e$[90]
0.012 thousand cf natural gas	0.0007 $MTCO_2e$
0.00018 thousand gallons fuel oil	0.0016 $MTCO_2e$

Implementation Summary

This action assumes installation of more efficient clothes washers in 14,263 households over a 20 year period.

This action can be accomplished as follows:

Implementation unit:	10 washers
Implementation units needed:	1,426

Implementation Schedule

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0.25	0.25	0.25	0.25	1.0
No. units	357	357	357	57	1,426
$MTCO_2e$	33.62	33.62	33.62	33.62	1,426

Upon full implementation, this action may offer the following savings per year.[91]

Electricity	242,471 kWh	$58,200
Natural Gas	171 thousand cf	$2,500
Light fuel oil	3 thousand gallons	$6,800

This action may result in average annual utility savings per household of approximately $5 plus minimal water costs.

Additional Considerations

An in-place utility program provides for clothes washer replacement, free of charge, to income-eligible residents, but this is not as great a priority program as freezer or air conditioner replacement programs. This Energy Plan considers natural retirement of clothes washers beyond the existing utility program. Within the twenty-year time frame of this Energy Plan, it is assumed that one quarter of Bridgeport households will replace clothes washers.

Measures carried out under the clothes washer replacement program, are estimated to create job potential for 29 fulltime equivalent work-years.[92]

- ***Sub Action 4.6 - Dishwasher Trade-ins***
  Goal: Trade in dishwashers in 50% of households, which is 23,772 households by 2030.

Annual Savings Potential by 2030 **132 $MTCO_2e$**

Per household savings potential

3 kWh[93]	0.001 $MTCO_2e$[94]
0.016 thousand cf natural gas	0.001 $MTCO_2e$
0.00036 thousand gallons fuel oil	0.003 $MTCO_2e$

Implementation Summary

This action assumes installation of more efficient dishwashers in 23,772 households over a 20 year period of natural retirement.

This action can be accomplished as follows:

Implementation unit:	10 dishwashers
Implementation units needed:	2,377

Implementation Schedule

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0.25	0.25	0.25	0.25	1.0
No. units	594	594	594	594	2,377
$MTCO_2e$	32.88	32.88	32.88	32.88	132

Upon full implementation, this action may offer the following savings per year.[95]

Electricity	71,316 kWh	$17,100
Natural Gas	380 thousand cf	$5,600
Light fuel oil	9 thousand gallons	$22,700

This action may result in average annual utility savings per household of approximately $2 plus minimal water savings.

Additional Considerations

An in-place utility program provides for dishwasher replacement, free of charge, to income-eligible residents, but this is not as great a priority program as freezer or air conditioner replacement programs. This Energy Plan considers natural retirement of dishwashers beyond the existing utility program. Within the twenty-year time frame of this Energy Plan, it is assumed that one half of Bridgeport households will replace dishwashers.

Measures carried out under the dishwasher trade-in program are estimated to create job potential for 48 fulltime equivalent work-years.

- ***Sub Action 4.7 - Low flow showerhead installation***
  Goal: Install Low Flow Showerheads in 20% of existing households.

Annual Savings Potential by 2030 **1,966 $MTCO_2e$[96]**

Per household savings potential

27.5194 kWh[97]	0.0114 $MTCO_2e$[98]
1.458 thousand cf natural gas	0.0834 $MTCO_2e$
0.0120 thousand gallons fuel oil	0.1120 $MTCO_2e$

Implementation Summary

This action assumes installation of one low flow showerhead in 9,508 households (20% of existing households) through actions which are separate from CEEF-supported utility programs.

This action can be accomplished as follows:

Implementation unit:	10 households
Implementation units needed:	951

Implementation Schedule

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0.4	0.3	0.2	0.1	1.0
No. units	380	285	190	95	951
$MTCO_2e$	786	590	393	197	1,966

Upon full implementation, this action may offer the following savings per year.[99]

Electricity	261,654 kWh	$62,800
Natural Gas	13, 863 thousand cf	$205,300
Light fuel oil	114 thousand gallons	$301,200

This action may result in average annual utility savings per household of approximately $60 plus water savings.

Additional Considerations

This action assumes installation of low flow showerheads separate and distinct from showerhead installation associated with utility programs cited in Energy Plan Action items 3.1 Home Energy Solutions and 3.2 Income Eligible, which both include showerhead installation, if feasible.

Showerheads can be easy to install in some applications, but not all. Installing a low flow showerhead saves water. Equally important, it reduces hot water flow. This means less fuel is needed to heat water, so additional savings result.

Measures carried out under the showerhead installation program, are estimated to create job potential for 2 fulltime equivalent work-years.[100]

- ***Sub Action 4.8 - Faucet aerator installation***
  Goal: Install water flow-reducing aerators in 20% of existing households.

Annual Savings Potential by 2030[101] **117 $MTCO_2e$**

Per household savings potential

1.6464 kWh electricity[102]	0.001 $MTCO_2e$[103]
0.0852 thousand cf natural gas	0.005 $MTCO_2e$
0.0008 thousand gallons fuel oil	0.007 $MTCO_2e$

Implementation Summary

This action assumes installation of two water-reducing faucet aerators in 9,508 households (20% of existing households) through actions which are separate from CEEF-supported utility programs.

This action can be accomplished as follows:

Implementation unit:	10 households
Implementation units needed:	951

Implementation Schedule

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0.4	0.3	0.2	0.1	1.0
No. units	380	285	190	95	951
$MTCO_2e$	47	35	23	12	117

Upon full implementation, this action may offer the following savings per year.[104]

Electricity	15,654 kWh	$3,800
Natural Gas	810 thousand cf	$12,000
Light fuel oil	7 thousand gallons	$18,100

This action may result in average annual utility savings per household of approximately $3 plus water savings.

Additional Considerations

This action assumes installation of 2 faucet aerators separate and distinct from aerator installation associated with utility programs cited in Energy Plan Action items 3.1 Home Energy Solutions and 3.2 Income Eligible, which both include aerator installation, if feasible.

Aerators cost less than $1 each. They are easy to install in most applications, but not all. Aerators are low-cost money-savers, bringing savings on water bills and water heating costs.

Aquarion, the water supply company, has an in-place program for water education and outreach in a number of schools. In some instances, aerators are included as "give-aways" in these programs.

Faucet aerators are assumed to be self-installed so it is estimated that this action item only creates indirect employment opportunities.

- ***Sub Action 4.9 - Install on-demand gas water heaters***
  Goal: Replace 15% of existing residential gas fueled water heaters with high efficiency gas water heating system- indirect or on-demand.

Annual Savings Potential by 2030 **1,239 $MTCO_2e$**

Per household savings potential

6.085 thousand cf natural gas[105] 0.348 $MTCO_2e$[106]

Implementation Summary

This action assumes installation of residential gas fueled water heaters with high efficiency gas water heating system – indirect or on-demand in 3,560 existing households.

This action can be accomplished as follows:

Implementation unit: 10 households

Implementation units needed: 356

Implementation Schedule

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0.3	0.4	0.2	0.1	1.0
No. units	107	142	71	36	356
$MTCO_2e$	372	495	248	124	1,239

Upon full implementation, this action may offer the following savings per year.[107]

Natural Gas 21,663 thousand cf $320,800

This action may result in average annual utility savings per building of approximately $90**.**

Additional Considerations

This action item proposes to tie into an existing utility program, which offers a $300 rebate for installation of certain indirect heating or on-demand tankless water heaters.

After house heating and cooling, hot water heating is the next largest energy user in most homes. Tankless water heaters can reduce energy consumption for water heating by 10% to 15% because it eliminates losses, which occur when no hot water is being used.[108] *On-demand gas-fired units or, for oil-customers, indirect tank, or integrated systems, are more efficient than most systems in use today, particularly electric- water heater systems.*

Installation of tankless or on-demand water heating systems described in this action item is estimated to create job potential for 9 fulltime equivalent work-years.[109]

ACTION 5 BUILD GREEN

- **Sub Action 5.1 - Residential Green Building (includes 5.1.a, 5.1.b, 5.1.c)**
- **Sub Action 5.1.a - Retrofit existing residential buildings**
  Goal: Achieve 25% savings in nearly three quarters of existing households through green building retrofits.

Annual Savings Potential by 2030 **49,520 $MTCO_2e$**

Per household savings potential

1, 737 kWh[110]	0.721 $MTCO_2e$[111]
8.93 thousand cf natural gas	0.511 $MTCO_2e$
0.024 gallons fuel oil	0.258 $MTCO_2e$

Implementation Summary

This action assumes performance of green building measures related to energy systems and building envelopes in 33,280 households, which is 70% of existing households. **Although included in the "Build Green" section, the measures proposed by Sub Action 5.1.a do not relate to complete new construction.** This Sub Action assumes completion of *intensive* retrofit measures to improve envelope plus energy system efficiency. These measures include such actions as new heating system installation, programmable thermostat installation and window and door retrofit, distinct from the less intensive retrofit measures in Action 3 of this Bridgeport Energy Plan (caulking, weather-stripping, light bulb switch outs, water flow reduction measures and ceiling insulation, etc).

This action can be accomplished as follows:

Implementation unit:	10 households
Implementation units needed:	3,328

Implementation Schedule

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0.2	0.3	0.4	0.1	1.0
No. units	665	998	1,331	332	3,328
$MTCO_2e$	9,904	14,856	19,808	4,952	49,520

Upon full implementation, this action may offer the following savings per year.[112]

Electricity	57,822,566 kWh	$13,877,400
Natural Gas	297,123 thousand cf	$4,400,400
Light fuel oil	813 thousand gallons	$2,153,200

This action may result in average annual utility savings per building of approximately $600. Initial investment will likely cost tens of thousands of dollars.

Additional Considerations

New heating (and in some instances) cooling systems are expected to replace less efficient units in many residential buildings through natural replacement during the next twenty years, bringing reduced energy use and emissions. Building envelope retrofit is essential to optimizing savings, but is less likely to occur since natural replacement cycle of windows is considerably longer than that of heating/cooling systems and the same "necessity" of action does not exist.

On average, it costs less than 2% more to retrofit buildings in a green manner than not, and buildings are increasingly being built to LEED certified levels at little or no extra cost.[113] Green building has been reported to have 20-year net benefits ranging from $50 to $65 per square foot.[114]

In-place utility company programs currently provide some financial incentive to heating/cooling system replacement. Financial incentive programs for upgrading building envelopes could be a key factor in achieving greater energy and emissions savings. Bridgeport's electric utility, UI, currently offers loans through a vendor for between $2,500 and $20,000, with interest rates as low as 0%, for a variety of efficiency measures. To receive 0% financing, comprehensive work, such as new air conditioning and insulation, must be done

Bridgeport's recently amended zoning regulations enable the construction of many thousand new households through infill of the existing building grid. This represents a tremendous opportunity to beneficially impact the regional emissions load. Buildings which are underutilized, and undergo expansion, complete renovation

and/or replacement will, out of deference to current equipment availability, install systems and equipment, which are, on average, the most energy-efficient of recent times.

Existing building and energy codes demand greater attention to energy efficiency. Although Bridgeport is not economically positioned to place green building requirements on new construction, The City can certainly, explore certain incentive programs and public education programs, to promote green building performance measures in new construction, as well as renovation. Educational programs could be developed together with the Bridgeport Regional Business Council, utilities, architects and landscape architects. A core working group on green construction will easily evolve out of the BGreen 2020 Energy Technical Subcommittee to address these issues. Time of sale may provide an opportunity for energy efficiency implementation.[115]

The Connecticut Energy Advisory Board, in 2010, established energy efficiency and conservation as the top priority for energy management in Connecticut. It recommends implementation of all achievable cost effective measures.

The CEAB also recommends creation of additional financing programs to supplement the utility-supported programs, which are currently funded by a small charge on all electric utility bills.

The EID may play a pivotal role in creating financing programs, which help expand residential retrofit activity to include more complete, or "intensive" actions.

The Mayor's Conservation Corps may also play a pivotal role by expanding outreach to increase participation in residential energy-saving programs. Particular attention must be paid by the Conservation Corps and utilities to establish a successful mechanism for engaging non-resident landlords in program participation.

Performing green building measures in existing households are estimated to create job potential for 1,864 fulltime equivalent work-years.[116]

- **Sub Action 5.1 - Residential Green Building (includes 5.1.a, 5.1.b, 5.1.c)**
- ***Sub Action 5.1.b - Green building in new residential construction Low Growth***
- ***Sub Action 5.1.c - Green building in new residential construction High Growth***

  Goal: Achieve 30% emissions reduction in all new households through green building practices.

Annual Savings Potential by 2030 (Low Growth)	**13,612 $MTCO_2e$**
Additional Annual Savings Potential by 2030 (High Growth)	**14,285 $MTCO_2e$**

Per household savings potential

2,084.95 kWh electricity[117]	0.866 $MTCO_2e$[118]
10.71 thousand cf natural gas	0.613 $MTCO_2e$
0.029 thousand gallons oil	0.309 $MTCO_2e$

Implementation Summary

This action assumes performance of green building measures related to energy systems and building envelopes, which will achieve 30% emissions savings in 7,623 new households under the Low Growth Scenario (Sub Action 5.2) and 8,000 new households under the High Growth Scenario (Sub Action 5.3).

- ***Sub Action 5.1.b (Low Growth) can be accomplished as follows:***

Implementation unit: 10 buildings
Implementation units needed: 762

Implementation Schedule

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0.25	0.25	0.25	0.25	1.0
No. units	191	191	191	191	762[119]
$MTCO_2e$	3,403	3,403	3,403	3,403	13,612

Upon full implementation, this action may offer the following savings per year.[120]

Electricity	15,893,561 kWh	$3,814,500
Natural Gas	81,669 thousand cf	$1,209,500
Light fuel oil	223 thousand gallons	$591,800

- ***Sub Action 5.1.c (High Growth) can be accomplished as follows:***

Implementation unit: 10 buildings
Implementation units needed: 800

Implementation Schedule

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0	0.2	0.4	0.4	1.0
No. units	0	160	320	320	800
$MTCO_2e$	0	2,857	5,714	5,714	14,285

Upon full implementation, this action may offer the following savings per year.[121]

Electricity	16,679,586 kWh	$4,003,100
Natural Gas	85,708 thousand cf	$1,269,300
Light fuel oil	234 thousand gallons	$621,100

This action may result in average annual utility savings per building of approximately $750.

Additional considerations

Bridgeport's recently amended zoning regulations enable the construction of many thousand new households through infill of the existing building grid. This represents a tremendous opportunity to beneficially impact the regional emissions load. Buildings which are underutilized, and undergo expansion, complete renovation and/or replacement will, out of deference to current equipment availability, install systems and equipment, which are, on average, the most energy-efficient of recent times.

On average, it costs less than 2% more to retrofit buildings in a green manner than not, and buildings are increasingly being built to LEED certified levels at little or no extra cost.[122] *Green building has been reported to have 20-year net benefits ranging from $50 to $65 per square foot.*[123]

Existing building and energy codes demand greater attention to energy efficiency. Although Bridgeport is not economically positioned to place green building requirements on new construction, The City can certainly, explore certain incentive programs and public education programs, to promote green building performance measures in new construction, as well as renovation. Educational programs could be developed together with the Bridgeport Regional Business Council, utilities, architects and landscape architects. A core working group on green construction will easily evolve out of the BGreen 2020 Energy Technical Subcommittee to address these issues.

"Building Green" is not anticipated to create any <u>incremental</u> job potential beyond normal construction trade demand, so this action item creates no additional fulltime equivalent work-years. However, Bridgeport's tremendous potential for redevelopment poses significant potential for employment in the construction trades.

- **Sub Action 5.2 - Commercial Green Building (includes 5.2.a and 5.2.b)**
- **Sub Action 5.2.a -** ***Green building in new commercial construction Low Growth***
- ***Sub Action 5.2.b - Green building in new commercial construction High Growth***

  Goal: Achieve 30% emissions reduction in all new commercial buildings through green building practices.

Annual Savings Potential by 2030 (Low Growth)	**8,768 $MTCO_2e$**
Additional Savings Potential by 2030 (High Growth)	**7,402 $MTCO_2e$**

Per buildings savings potential

575,250 kWh electricity[124]	238 $MTCO_2e$[125]
2,462 thousand cf natural gas	141 $MTCO_2e$

Implementation Summary

This action assumes performance of green building measures related to energy systems and building envelopes, which will achieve 28% emissions savings in 231 new commercial buildings under the Low Growth

Scenario (Sub Action 5.4) and 195 new commercial buildings under the High Growth Scenario (Sub Action 5.5). This falls slightly short of the 30% reduction goal.

- ***Sub Action 5.2.a (Low Growth) can be accomplished as follows:***

Implementation unit: 10 buildings
Implementation units needed: 23.1

Implementation Schedule

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0.25	0.25	0.25	0.25	1.0
No. units	6	6	6	6	24
$MTCO_2e$	2,192	2,192	2,192	2,192	8,768

Upon full implementation, this action may offer the following savings per year.[126]

Electricity	13,288,275 kWh	$3,189,200
Natural Gas	56,872 thousand cf	$522,100

- ***Sub Action 5.2.b (High Growth) can be accomplished as follows:***

Implementation unit: 10 buildings
Implementation units needed: 19.5

Implementation Schedule

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0	0.2	0.4	0.4	1.0
No. units	0	3.9	3.9	7.8	19.5
$MTCO_2e$	0	1,480	2,961	2,961	7402

Upon full implementation, this action may offer the following savings per year.[127]

Electricity	11,217,375 kWh	$2,692,200
Natural Gas	48,009 thousand cf	$440,700

This action may result in average annual utility savings per building of approximately $15,000.

Additional Considerations

The technology exists to construct buildings with 30% or greater energy savings over currently standing structures. On average, it costs less than 2% more to retrofit buildings in a green manner than not, and buildings are increasingly being built to LEED certified levels at little or no extra cost.[128] Green building has been reported to have 20-year net benefits ranging from $50 to $65 per square foot.[129]

This measure proposes that all new construction take advantage of the existing Energy Conscious BluePrint utility-managed program, or similar, to plan for new commercial construction, which installs efficient energy

systems. Complementing the Energy Conscious BluePrint planning program are several financing programs, including rebates and loans against consumption.

Bridgeport's tremendous potential for redevelopment poses significant opportunity to institute green building measures not only in expected new buildings, but also in major renovation of existing buildings, which, in essence, will be new construction. The existing Energy Conscious Blue Print program also encompasses major retrofit and renovation.

New commercial construction should, in its related design and planning process, consider inclusion of renewable energy opportunities, combined heat and power and distributed generation, which are addressed in the Renewable Resources section of this energy plan.

"Building Green" is not anticipated to create any incremental job potential beyond normal construction trade demand, so this action item creates no additional fulltime equivalent work-years. However, Bridgeport's tremendous potential for redevelopment poses significant opportunity for employment in the construction trades.

SEE APPENDIX for Cost Saving Opportunities related to green construction and retrofit.

ACTION 6 COOL WITH TREES AND GREEN ROOFS

- ***Sub Action 6.1 - Plant 2 or 3 trees at half of the city's residential buildings***
  Goal: Save 3% of heating and cooling energy[130] in 50% of residential buildings[131] through tree planting.

Annual Savings Potential by 2030 **2,288 $MTCO_2e$**

Per household savings potential

243 kWh electricity[132]	0.10 $MTCO_2e$[133]
1.2474 thousand cf natural gas	0.07 $MTCO_2e$
0.0034 thousand gallons fuel oil	0.04 $MTCO_2e$

Implementation Summary

This action may be accomplished by planting 27,510 trees in the residential sector. Two or three trees can be planted at 11,004 buildings as follows.

Implementation unit:	10 buildings
Implementation units needed:	1,100

Implementation Schedule

2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total

Percent	0.4	0.4	0.2	0	1.0
No. units	440	440	220	0	1,100
$MTCO_2e$	915	915	458	0	2,288
Trees[134]	11,004	11,004	5,502	0	27,510

Upon full implementation, this action may offer the following savings per year.[135]

Electricity	2,671,347 kWh	$2,600
Natural Gas	13,727 thousand cf	$203,300
Light fuel oil	38 thousand gallons	$99,500

This action may result in average annual utility savings per building of approximately $75.

Additional Considerations

Trees have value to energy savings, the natural environment, quality of life, and water management.

The City of Bridgeport has recently started an "Adopt-a-Tree" program. This program can look to expand through focused outreach and education and a highly visible tree planting campaign. Sufficient administrative support will be essential. It is possible that a citizens group may provide some of the backbone for this program to support the Parks Department efforts. The potential for communitywide participation in tree planting and sponsorship is high.

The City can benefit from expanding its existing urban forest database through specific ITree/UFORE and/or UTC assessment. Additional data may help direct a tree-planting program toward established goals beyond tree number, to include specific water management and/or air quality goals.

The City cannot fund this on its own and private property ownership requires residents to partner with the City on this effort.

Groundwork Bridgeport can be a valuable resource in this effort, drawing upon established strengths, which align with this action.

Measures carried out under the Bridgeport tree-planting program are estimated to create job potential for 55 fulltime equivalent work-years. This will be reduced if some trees are self-installed.

- ***Sub Action 6.2 - Plant trees at commercial building sites***
  Goal: Plant trees at 80% of the existing commercial buildings that are under 3 stories tall to reduce building energy by 3%.

Annual Savings Potential by 2030 **3874 $MTCO_2e$**

Per building savings potential

2,967 kWh electricity[136]	1.23 $MTCO_2e$[137]
15.802 thousand cf natural gas	0.90 $MTCO_2e$
0.034 thousand gallons oil	0.36 $MTCO_2e$

Implementation Summary

This action may be accomplished by planting trees in the commercial sector. Six to nine trees can be planted at 1,555 buildings as follows.

Implementation unit:	10 buildings
Implementation units needed:	155

Implementation Schedule

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0.4	0.4	0.2	0	1.0
No. units	62	62	31	0	155
$MTCO_2e$	1,550	1,550	775	0	3,874
Trees[138]	5,894	5,894	2,947	0	14,734

Upon full implementation, this action may offer the following savings per year.[139]

Electricity	4,613,925 kWh	$1,107,300
Natural Gas	24,572.249 thousand cf	$225,600
Light fuel oil	53 thousand gallons	$139,900

This action may result in average annual utility savings per building of approximately $1,000.

Additional Considerations

Trees have value to energy savings, the natural environment, quality of life, and water management.

The City of Bridgeport has recently started an "Adopt-a-Tree" program. This program can expand through focused outreach and education and a highly visible tree planting campaign. Sufficient administrative support will be essential. It is possible that a citizens group may provide some of the backbone for this program to support the Parks Department efforts. The potential for communitywide participation in tree planting and sponsorship is high.

The City can benefit from expanding its existing urban forest database through specific ITree/UFORE and/or UTC assessment. Additional data may help direct a tree-planting program toward established goals beyond tree number, to include specific water management and/or air quality goals.

The City cannot fund this alone; and private property ownership requires that businesses partner with the City on this effort.

Groundwork Bridgeport can be an instrumental resource in citywide planting programs, drawing upon established strengths, which align with this action.

Measures carried out under the Bridgeport tree-planting program are estimated to create job potential for 29 fulltime equivalent work-years. This will be reduced if some trees are self-installed.

- ***Sub Action 6.3. - Install green roofs on 30% of existing flat roof commercial buildings***
- ***Sub Action 6.4 and Sub Action 6.5 - Install green roofs on 30% new flat roof commercial buildings***
  Goal: Achieve 3% savings on individual building heating and cooling energy through green roof installation.

Annual Savings Potential by 2030 Existing Buildings	**9,282 $MTCO_2e$**
Annual Savings Potential new buildings (Low Growth)	**1,049 $MTCO_2e$**
Additional annual savings potential (High Growth)	**888 $MTCO_2e$**

Per building savings potential

24,030 kWh electricity[140]	9.98 $MTCO_2e$
4.098 thousand cf natural gas	7.32 $MTCO_2e$
1.615 thousand gallons oil	2.88 $MTCO_2e$

Implementation Summary

This action assumes installation of a green roof on 460[141] existing commercial buildings, 52 new commercial buildings under Low Growth scenario, and an additional 44 commercial buildings under the High Growth scenario for a total of 512 to 556 buildings.

This action can be accomplished as follows:

- ***Sub Action 6.3 - 460 Existing buildings***

Implementation unit:	1 building
Implementation units needed:	460

Implementation Schedule

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0.1	0.3	0.4	0.2	1.0
No. units	46	138	184	92	460
$MTCO_2e$	928	2,784	3,713	1,856	9,282

Upon full implementation, this action may offer the following savings per year.[142]

Electricity	11,053,802 kWh	$2,652,900
Natural Gas	1884.85 thousand cf	$27,900
Light fuel oil	743.04 thousand gallons	$1,969,000

- ***Sub Action 6.4 - 52 New buildings Low Growth***

Implementation unit: 1 building
Implementation units needed: 52

Implementation Schedule

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0.1	0.3	0.4	0.2	1.0
No. units	5	16	21	10	52
$MTCO_2e$	105	315	420	210	1,049

Upon full implementation, this action may offer the following savings per year.[143]

Electricity	1,249,560 kWh	$299,900
Natural Gas	213 thousand cf	$2,000
Light fuel oil	84 thousand gallons	$222,600

- ***Sub Action 6.5 - 44 New buildings High Growth***

Implementation unit: 1 building
Implementation units needed: 44

Implementation Schedule

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0.1	0.3	0.4	0.2	1.0
No. units	4	13	18	9	44
$MTCO_2e$	89	266	355	178	888

Upon full implementation, this action may offer the following savings per year.[144]

Electricity	1,057,320 kWh	$253,757
Natural Gas	180.29 thousand cf	$1,700
Light fuel oil	71.07 thousand gallons	$188,300

This action may result in average annual utility savings per building of approximately $10,000.

Additional considerations

Rooftops are an untapped carbon reduction resource. Several critical elements must be addressed to maximize their potential. First and foremost is the need to determine the optimal use of roof space, which could either be assigned to green roof or to solar. Solar/green roof combinations can have many benefits.

Optimizing the mix of these two opportunities is important. The EID could play a vital role in commissioning study to develop models for commercial property owners to draw from. Although green roofs have a higher initial cost than traditional roofs, they return savings in many ways, and last two- to three times as long as conventional roofs.[145]

The EID, City and Bridgeport Regional Business Council BGreen partners can play a strategic role in marketing the merits of an optimal solar/green roof mix to commercial property owners.

For additional information on green roof actions related to water management, see Water Resources Part 6 of this Bridgeport Energy Plan

Measures carried out under the green roof program on existing buildings are estimated to create job potential for 743 fulltime equivalent work-years. Measures carried out under the green roof program on new buildings under the Low Growth and High Growth scenarios combined are estimated to create job potential for 155 fulltime equivalent work-years.[146]

- ***Sub Action 6.6 - Carbon sequestration in newly-planted trees***
  Goal: Sequester carbon in Bridgeport's urban forest

Annual Savings Potential by 2030 **1,479 $MTCO_2e$**

Savings potential per 20 trees 0.0350 $MTCO_2e$[147]
Specific types of energy or fuel savings were not quantified by this energy plan.

Implementation Summary
This action assumes carbon will be sequestered in 42,244 newly-planted trees as described under Sub Actions 6.1 and 6.2.

This action can be accomplished as follows:
Implementation unit: 20 trees
Implementation units needed: 2,112

Implementation Schedule

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0.4	0.4	0.2	0	1.0
No. units	845	845	422	0	2,112
$MTCO_2e$	591	591	296	0	1,479

Upon full implementation, this action may offer electricity, natural gas and/or fuel oil savings, but specific savings were not allocated by fuel type.

Additional Considerations

Carbon sequestration in newly planted trees relates to actions taken under Sub Actions 6.1 and 6.2, which, combined, are estimated to create job potential for 84 fulltime equivalent work-years. This will be lessened if some trees in the residential sector are self-installed.

- ***Sub Action 6.7 - Carbon sequestration in newly-planted green roofs***
  Goal: Sequester carbon in urban vegetation established on commercial green roofs.

Annual Savings Potential by 2030 **$MTCO_2e$ not quantified**[148]

Implementation Summary

This action assumes carbon will be sequestered in 512 to 556 newly established green roofs as described under Sub Actions 6.3 and 6.4.

Upon full implementation, this action may offer electricity, natural gas and/or fuel oil savings, but specific savings were not allocated by fuel type.

Additional Considerations

Carbon sequestration in newly planted green roofs relates to actions taken under Sub Actions 6.3, 6.4 and 6.5, which, combined, are estimated to create job potential for 898 fulltime equivalent work-years.

ACTION 7 BEHAVIORAL CHANGES TO SAVE ENERGY AND REDUCE EMISSIONS

- ***Sub Action 7.1 - Four behavioral changes in 5% existing households***
- ***Sub Action 7.2 - Four behavioral changes in 5% new households under Low Growth scenario***
- ***Sub Action 7.3 - Four behavioral changes in 5% new households under High Growth scenario***
  Goal: Adopt four behavioral changes to reduce energy consumption and reduce household emissions by more than ½ $MTCO_2e$ (0.63 $MTCO_2e$) at 5% of existing and future households.

Annual Savings Potential by 2030 Existing households	**1,501 $MTCO_2e$**
Annual Savings Potential by 2030 new households (Low Growth)	**241 $MTCO_2e$**
Additional annual savings potential new households (High Growth)	**253 $MTCO_2e$**

Per household savings potential

1,149 kWh electricity[149]	0.48 $MTCO_2e$
1.8 thousand cf natural gas	0.10 $MTCO_2e$

0.005 thousand gallons oil	0.05 $MTCO_2e$

Implementation Summary

This action assumes behavioral changes are implemented in 2,377 existing households, 382 new households under the Low Growth scenario, and an additional 400 new households under the High Growth scenario. The behavioral changes included in this measure are 1) changing heating and cooling by 3 degrees, 2) changing filters on air conditioners to achieve 10% savings, 3) turning off three 60-watt light bulbs for 2 hours a day, and 4) turning off appliances which contribute to the "phantom load."

This action can be accomplished as follows:

- ***Sub Action 7.1 - Four behavioral changes in 5% existing households***

Implementation unit:	10 households
Implementation units needed:	238

Implementation Schedule

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0.5	0.4	0.1	0	1.0
No. units	119	95	24	0	238
$MTCO_2e$	751	600	150	0	1,501

Upon full implementation, this action may offer the following savings per year.[150]

Electricity	2,730,828 kWh	$655,400
Natural Gas	4,728 thousand cf	$63,400
Light fuel oil	12 thousand gallons	$31,000

- ***Sub Action 7.2 - Four behavioral changes in 5% new households under Low Growth scenario***

Implementation unit:	10 households
Implementation units needed:	38.2

Implementation Schedule

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0.25	0.25	0.25	25	1.0
No. units	10	10	10	10	40
$MTCO_2e$	60	60	60	60	241

Upon full implementation, this action may offer the following savings per year.[151]

Electricity	438,863 kWh	$105,327
Natural Gas	688 thousand cf	$10,200
Light fuel oil	2 thousand gallons	$5,000

- ***Sub Action 7.3 - Four behavioral changes in 5% new households under High Growth scenario***

Implementation unit: 10 households
Implementation units needed: 40

Implementation Schedule

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0	0.2	0.4	0.4	1.0
No. units	0	8	16	16	40
$MTCO_2e$	0	51	101	101	253

Upon full implementation, this action may offer the following savings per year.[152]

Electricity	459,542 kWh	$110,290
Natural Gas	720 thousand cf	$10,700
Light fuel oil	2 thousand gallons	$5,200

This action may result in average annual utility savings per household of approximately $300.

Additional Considerations

This set of actions is only projected to be implemented in 5% of households due to anticipated reluctance to undertake the fourth item in the package: turn off appliances that contribute to phantom load. This same set of actions, minus the action related to phantom load reduction, is expected to be implemented in 65% of households (see Sub Actions 7.4, 7.5 and 7.6).

Education is the key to implementing this action. It will be most effective if it demonstrates the economic upside of participating in the described actions.

The Mayor's Conservation Corps can play a critical leadership role in educating residents to the many benefits of making behavioral changes.

Community groups must also be leaders in promoting conservation behavior.

In-place utility company educational programs provide a certain degree of outreach to schools, in retail sales centers, at a smart living energy center, and at The Discovery Museum in Bridgeport. A valuable portal of opportunity exists to add conservation and efficiency education to afterschool programs, which serve several thousand families daily.

The behavioral changes described in this action are self-directed and create only minimal indirect employment opportunity.

- ***Sub Action 7.4 - Three behavioral changes in 65% existing households***

- ***Sub Action 7.5 - Three behavioral changes in 65% new households under Low Growth scenario***
- ***Sub Action 7.6 - Three behavioral changes in 65% new households under High Growth scenario***

  Goal: Adopt three behavioral changes to reduce energy consumption and reduce household emissions by 0.51 $MTCO_2e$ at 65% of existing and future households.

Annual Savings Potential by 2030 Existing households	**15,948 $MTCO_2e$**
Annual Savings Potential by 2030 new households (Low Growth)	**2,557 $MTCO_2e$**
Additional annual savings potential new households (High Growth)	**2,684 $MTCO_2e$**

Per household savings potential

871 kWh electricity[153]	0.36 $MTCO_2e$
1.8 thousand cf natural gas	0.10 $MTCO_2e$
0.005 thousand gallons oil	0.05 $MTCO_2e$

Implementation Summary

This action assumes behavioral changes are implemented in 30,902 existing households, 4,955 new households under the Low Growth scenario, and an additional 5,200 new households under the High Growth scenario. The behavioral changes included in this measure are 1) changing heating and cooling by 3 degrees, 2) changing filters on air conditioners to achieve 10% savings, and 3) turning off three 60-watt light bulbs for 2 hours a day.

This action can be accomplished as follows:

- ***Sub Action 7.4 - Three behavioral changes in 65% existing households***

Implementation unit:	10 households
Implementation units needed:	3,090

Implementation Schedule

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0.5	0.4	0.1	0	1.0
No. units	1,545	1,236	309	0	3,090
$MTCO_2e$	7974	6379	1595	0	15,948

Upon full implementation, this action may offer the following savings per year.[154]

Electricity	26,911,367 kWh	$6,458,700
Natural Gas	55,620 thousand cf	$823,700
Light fuel oil	152 thousand gallons	$403,000

- ***Sub Action 7.5 - Three behavioral changes in 65% new households under Low Growth scenario***

Implementation unit: 10 households
Implementation units needed: 495.5

Implementation Schedule

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0.25	0.25	0.25	25	1.0
No. units	124	124	124	124	496
$MTCO_2e$	639	639	639	639	2,557

Upon full implementation, this action may offer the following savings per year.[155]

Electricity	4,315,120 kWh	$1,035,600
Natural Gas	8,918 thousand cf	$132,000
Light fuel oil	24 thousand gallons	$64,600

- ***Sub Action 7.6 - Three behavioral changes in 65% new households under High Growth scenario***

Implementation unit: 10 households
Implementation units needed: 520

Implementation Schedule

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0	0.2	0.4	0.4	1.0
No. units	0	104	208	208	520
$MTCO_2e$	0	537	1,073	1,073	2,684

Upon full implementation, this action may offer the following savings per year.[156]

Electricity	4,528,481 kWh	$1,086,800
Natural Gas	9,359 thousand cf	$138,600
Light fuel oil	25.6 thousand gallons	$67,800

This action may result in average annual utility savings per household of approximately $250.

Additional Considerations

Education is the key to implementing this action. It will be most effective if it demonstrates the economic upside of participating in the described actions.

The Mayor's Conservation Corps can play a critical leadership role in educating residents to the benefits of making behavioral changes.

Community groups must also be leaders in promoting conservation behavior.

In-place utility company educational programs provide a certain degree of outreach to schools, in retail sales centers, at a smart living energy center, and at The Discovery Museum in Bridgeport. A valuable portal of opportunity exists to add conservation and efficiency education to afterschool programs, which serve several thousand families daily.

The behavioral changes described in this action are self-directed and create only minimal indirect employment opportunity.

- ***Sub Action 7.7 - Two behavioral changes in 80% of existing commercial buildings***
- ***Sub Action 7.8 - Two behavioral changes in 80% of new buildings under Low Growth scenario***
- ***Sub Action 7.9 - Two behavioral changes in 80% of additional new buildings under High Growth scenario***

  Goal: Adopt two behavioral changes to reduce energy consumption and reduce emissions by nearly 20 $MTCO_2e$ at 80% of existing and future commercial buildings.

Annual Savings Potential by 2030 existing Buildings	**39,305 $MTCO_2e$**
Annual Savings Potential by 2030 new buildings (Low Growth)	**3,687 $MTCO_2e$**
Additional Annual Savings new buildings (High Growth)	**3,109 $MTCO_2e$**

Per building savings potential[157]

23,737 kWh electricity	9.85 $MTCO_2e$
126.42 thousand cf natural gas	7.23 $MTCO_2e$
0.272 thousand gallons oil	2.85 $MTCO_2e$

Implementation Summary

This action assumes two behavioral changes are implemented in 1,972 existing commercial buildings, 185 new commercial buildings under the Low Growth scenario, and 156 additional new commercial buildings under the High Growth Scenario. The behavioral changes included in this measure are: 1) changing heating and cooling in commercial buildings by 3 degrees and 2) changing the thermostat at commercial buildings to a programmable thermostat, which adjusts temperatures during work and nonwork hours.

This action can be accomplished as follows:

- ***Sub Action 7.7 - Two behavioral changes in 80% existing commercial buildings***

Implementation unit:	10
Implementation units needed:	197.2

Implementation Schedule

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0.5	0.4	0.1	0	1.0
No. units	99	79	20	0	198

$MTCO_2e$	19,652	15,722	3,930	0	39,305

Upon full implementation, this action may offer the following savings per year.[158]

Electricity	46,809,825 kWh	$11,234,400
Natural Gas	249,294 thousand cf	$2,288,500
Light fuel oil	535 thousand gallons	$1,419,000

- ***Sub Action 7.8 - Two behavioral changes in 80% new commercial buildings under Low Growth scenario***

Implementation unit: 10 buildings
Implementation units needed: 18.5

Implementation Schedule

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0.25	0.25	0.25	0.25	1.0
No. units	4.65	4.65	4.65	4.65	18.6
$MTCO_2e$	922	922	922	922	3,687

Upon full implementation, this action may offer the following savings per year.[159]

Electricity	4,391,388 kWh	$1,053,900
Natural Gas	23,387 thousand cf	$214,700
Light fuel oil	50 thousand gallons	$133,000

- ***Sub Action 7.9 - Two behavioral changes in 80% new commercial buildings under High Growth scenario***

Implementation unit: 10
Implementation units needed: 15.6

Implementation Schedule

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0	0.2	0.4	0.4	1.0
No. units	0	3	6	6	15
$MTCO_2e$	0	622	1,244	1,244	3,109

Upon full implementation, this action may offer the following savings per year.[160]

Electricity	3,703,008 kWh	$888,700
Natural Gas	19,721 thousand cf	$292,000
Light fuel oil	42 thousand gallons	$112,300

This action may result in average annual utility savings per building of approximately $8,000. Programmable thermostats can cost $40 -$160, but may require a professional for installation.[161]

Notes

Education and economics are the combined key to implementing this action. Success will rely on effectively demonstrating the economic upside of undertaking the described actions.

In-place utility company educational programs currently provide a degree of outreach to the business community. The Bridgeport Regional Business Council, a BGreen partner, can be a leader in promoting conservation behavior by serving as an educational resource repository.

The Mayor's Conservation Corps can also play a role in educating small business owners to the benefits of making behavioral changes.

The behavioral changes described in this action are self-directed and create only minimal indirect employment opportunity.

ACTION 8 UTILITY SCALE POLICIES AND PROGRAMS

- ***Sub Action 8.1 - Advanced Metering and Smart Grid***
  Goal: Reduce residential and commercial electricity emissions through utility level implementation of advanced metering and smart grid policies and procedures.

Annual Savings Potential by 2030 **$MTCO_2e$ not quantified**

Savings Potential, Implementation Summary, and Additional Considerations

Pilot programs are testing the effectiveness of these actions within and beyond Connecticut. CL&P noted 23% peak load reduction in residential electrical usage and 7% reduction in commercial peak demand, but little overall net reduction.[162] UI has also begun to implement its meter enhancement plan. Advanced metering infrastructure (AMI) – part of the "Smart Grid" concept – is expected to gain momentum in Connecticut. Enabling technologies are expected to help customers respond more effectively to price signals; AMI programs, which include these technologies, are anticipated by our utility companies to prove most successful. [163]

Upon full implementation, this action is expected to have sizable financial and electricity resource savings, but impact has not been quantified.

- ***Sub Action 8.2 - Power Plant Repowering***

Goal: Reduce residential and commercial electricity emissions through utility level transfer to cleaner fuels or technology at local power plants.

Annual Savings Potential by 2030 **$MTCO_2e$ not quantified**

Savings potential and Implementation Summary

Utility supply companies may repower existing power plants to operate with cleaner fuels, particularly switching away from coal as a fuel source. In depth analysis by utility companies for the Connecticut Energy Advisory Board[164] shows this action may actually increase local emissions of certain pollutants, although it would help decrease emissions regionally as part of the regional power supply. Although repowered plants will be more efficient, they are anticipated to be operated for additional time to help meet regional grid demand; Connecticut would, in fact, become a net exporter of electricity.

Upon full implementation, this action is expected to have sizable financial and electricity resource savings, but impact specific to Bridgeport has not been quantified.

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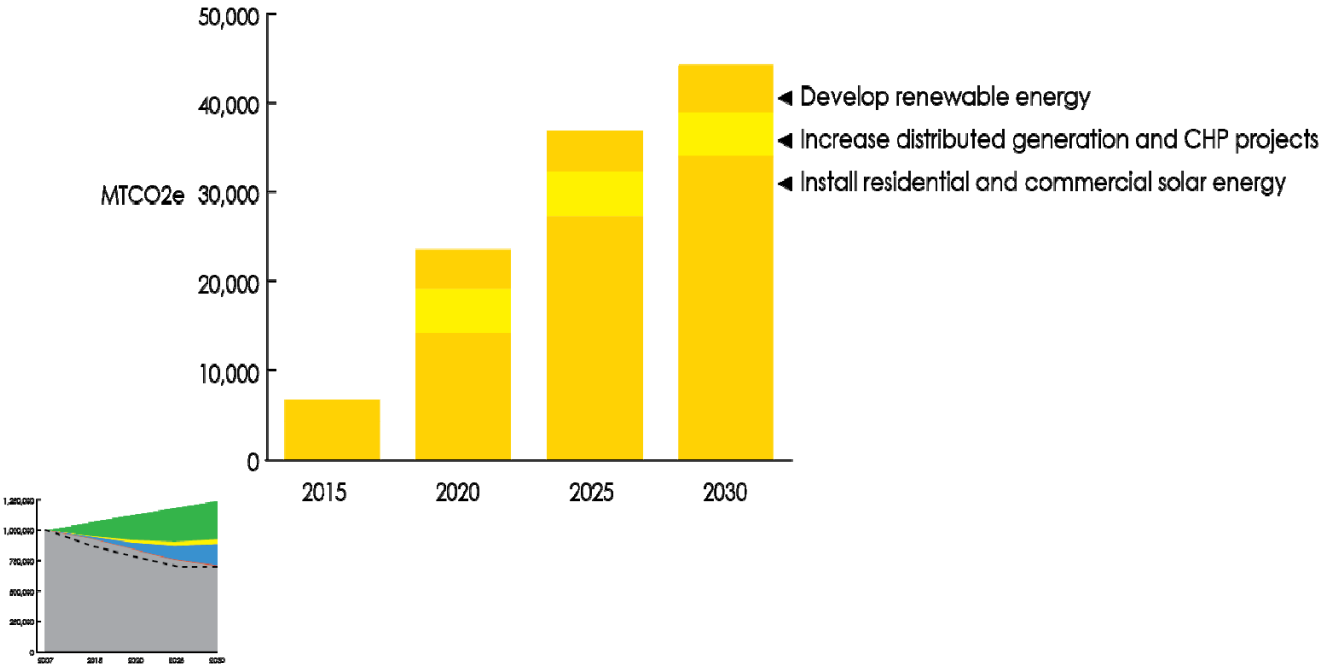
RENEWABLE ENERGY

SUMMARY

5.2% of total reduction 2010 to 2015

8.1% of cumulative reduction by 2030

Renewable and Clean Energy		**MTCO$_2$e**
Action 1	Renewable energy development	5,595
Action 2	Increase distributed generation and combined heat and power projects	4,921
Action 3	Residential and commercial solar energy	33,780
Action 4	Utility scale regional renewable energy development and transmission	--
	Annual Emissions Reduction by Full Implementation 2030	44,295



SAVINGS (annual by full implementation)	
Electricity	**$17.1 million**
Natural Gas	**$1.1 million**
Light Fuel Oil	**$1.4 million**
Gasoline/Diesel	**$0.95 million**
GAINS	
Fulltime equivalent work-years	**579**

Narrative Summary

- Clean and renewable energy strategies assume a steady spot between 5% and 10% of overall Plan reduction savings throughout the plan's twenty-year period.
- Several utility-scale renewable energy projects may be developed in Bridgeport, possibly beginning within 2 or 3 years. These include a 3 MW solar energy park near the closed Seaside Landfill, a 100KW on-shore windmill on City-owned property near the coast and a biogas retrofit on the City's West Side water treatment facility.
- Connecticut's Energy Advisory Board notes that costs of solar energy are still relatively high compared with weatherization and retrofit opportunities and also notes cost reductions are expected. Ramping up of household and commercial building site solar is delayed for several years under this plan. A City-initiated program, under development, and based on a power purchase agreement with a private entity, may enable earlier establishment of solar capacity, at an acceptable cost.
- Solar/green roof combinations can have many benefits. Optimizing the mix of these two opportunities is important. Marketing the merits of this mix to commercial property owners will be important.
- Solar thermal currently costs less than residential solar PV and residents can now benefit from a Connecticut Clean Energy Fund (CCEF) program and federal tax credits in support of its installation.
- Bridgeport's southern industrial core should be comprehensively analyzed for development of resource sharing opportunities, as several large players have heat and/or water "waste resources" that can benefit others.
- The Bridgeport EID and Planning and Economic Development Department must work jointly with the State DECD and CDA in identifying more potential for distributed generation, particularly given the power supply systems and resource recovery system near Bridgeport's waterfront.

- The City of Bridgeport can look to expand purchase of "green energy" and may find benefit to working with other municipalities in lower-cost group purchase.
- Connecticut Clean Choice option will help certain residents obtain "green electricity" which can help the City obtain solar PV systems for public facilities. Wind energy, a clean choice option, is viewed by electric suppliers to be the next pivotal piece in regional green generation and supply.
- Although far less than the estimated number of Green Buildings jobs, Renewables can provide employment opportunities in the hundreds of fulltime equivalent work years in Bridgeport.

ACTION 1 RENEWABLE ENERGY DEVELOPMENT

- ***Sub Action 1.1 - Develop Green Energy Park in closed landfill region***
  Goal: Create 3MW solar generation facility to contribute to the local grid, reduce reliance on fossil fuels and reduce fossil fuel emissions.

Annual Savings Potential by 2030 **170 $MTCO_2e$**

Project savings potential

Electricity	410,959 kWh[165]	170 MTCO2e[166]

Implementation Summary

This action assumes installation 3MW solar capacity at the closed Seaside Landfill. This may be coordinated with installation of wind generation on nearby properties, but this sub action considers 3 MW solar installation only.

This action can be accomplished as follows:

Implementation unit:	Single project
Implementation units needed:	1

Implementation Schedule

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	1.0	0	0	0	1.0
No. units	1	0	0	0	1.0
$MTCO_2e$	170	0	0	0	170

Upon full implementation, this action may offer the following savings per year.[167]

Electricity	410,959 kWh	$98,600

Combined annual savings for this completed measure is estimated to be $98,600 although savings will be matched against cost of implementation.

Additional Considerations

A major deterrent to expanded solar energy use is cost. The direct cost of electricity from solar is roughly ten times greater than the cost of wind, hydropower or combined cycle systems.[168] The Connecticut Energy Advisory Board reports that solar module prices are expected to drop as much as 30 percent in the next year or two, which would reduce installed costs about 15 percent from the current average installed cost of $7.50/watt for all systems. (Smaller systems cost more than this average per watt; larger systems cost less per watt.) The CEAB also notes that industry goals reported by SolarBuzz are a drop from $4+/watt to $1.5 to $2/watt by 2020 for module costs. Installed costs declined from $7.8/watt in 2007 to $7.5/watt in 2008. As a result of current and projected solar economics, CEAB currently recommends a delay in implementing significant solar installation as a means of meeting Connecticut's electricity supply.[169]

A feasibility study is underway to determine more specific potential for solar PV development at the former Seaside Landfill site.

Creation of a solar energy park will sustain employment in the building- and related specialty energy trades. Employment potential has not been quantified for this action item.

- ***Sub Action 1.2 - Develop electrical generation from on-shore wind in Bridgeport***
  Goal: Reduce emissions by 91 $MTCO_2e$ per year by installing on-shore electricity-generating wind facility.

Annual Savings Potential by 2030		**91 $MTCO_2e$**
Electricity	219,000 kWh[170]	91 $MTCO_2e$

Project savings potential

A single windmill with 100KW-installed capacity can, under Connecticut's current generation rules, provide savings to tied-in facilities. 219,000 kWh per year may be generated by this size facility.

Implementation Summary

This action assumes one 100KW[171] on-shore windmill will be established at one city location.

This action can be accomplished as follows:

Implementation unit:	1 windmill
Implementation units needed:	1

Implementation Schedule

2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total

Percent	1.0	0.3	0.2	0.1	1.0
No. units	1	0	0	0	1.0
$MTCO_2e$	91	0	0	0	91

Upon full implementation, this action may offer the following savings per year.[172]

Electricity	219,000 kWh	$52,600

Additional Considerations

The implementation schedule in this Bridgeport Energy Plan assumes full implementation within 5 years, which might be a bit too aggressive, considering pre-design wind measurements require more than 1 year to complete. Full implementation of this action might be pushed back to 2015-2020-time period.

Initial consideration is being given to installation on city-owned property near Captain's Cove.

Connecticut, and Bridgeport, are not considered high potential sites for on-shore wind generation, but a recently installed windmill in New Haven, funded with assistance from the Connecticut Clean Energy Fund, is proving successful.[173]

The cost of onshore wind development equals about $2,400/KW (current dollars), which is not expected to change much over time, other than through inflation, because wind is an established technology.[174]

In general, Connecticut utilities and the Connecticut Energy Advisory Board (CEAB) are looking to fulfill renewable portfolio standards through development of what is believed to be far greater on-shore wind potential in other New England and Northeastern states.

Development of wind energy in Bridgeport will sustain employment in the alternative energy and related electrical trades. Employment potential has not been quantified for this action item.

- ***Sub Action 1.3 Double municipal and BOE clean energy purchase from electric utilities***
  Goal: Achieve 40% green energy purchase for municipal and BOE facilities by 2030.

Annual Savings Potential by 2030		**3,695 $MTCO_2e$**
Electricity	8,900,000 kWh[175],[176]	3,695 $MTCO_2e$[177]

Implementation Summary

This action assumes a doubling of the current 20% purchase of "green" electricity to result in total use of 40% "green" electricity.

This action can be accomplished as follows:

Implementation unit: 50% increase in purchase
Implementation units needed: 2

Implementation Schedule

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0.5	0.5	0	0	1.0
No. units	1	1	0	0	2
$MTCO_2e$	1,847.5	1,847.5 0	0	0	3,695

Upon full implementation, this action may offer the following savings per year.[178]

Electricity	8,900,000 kWh	$2,136,000

Additional Considerations

The City must explore cost-effective ways to expand municipal and BOE clean energy purchase for electricity, and possibly work with adjacent municipal energy departments for regionalized active bidding of reduced-rate electricity.

- ***Sub Action 1.4 - Expand CTCleanEnergyOptions enrollment to 1% of Bridgeport households***
- ***Sub Action 1.5 - Promote CTCleanEnergyOptions enrollment by 1% of future households under Low Growth scenario***
- ***Sub Action 1.6 - Promote CTCleanEnergyOptions enrollment by 1% of future households under High Growth scenario***

  Goal: Expand CTCleanEnergyOptions enrollment (100% renewable option) from 0.4%[179] to 1% of existing households, and 1% of new households under Low Growth and Expand Growth scenarios, to reduce emissions and promote regional and national clean energy markets and generation.

Annual Savings Potential by 2030 existing households	**958 $MTCO_2e$**
Annual Savings Potential Low Growth scenario	**220 $MTCO_2e$**
Additional Annual Savings High Growth scenario	**231 $MTCO_2e$**

Per household savings potential

6950 kWh electricity[180]	2.9 $MTCO_2e$[181]

Implementation Summary

This action assumes 332 currently-existing-households will voluntarily switch to 100% renewable electricity purchase through the local utility and existing Connecticut Clean Choice option program and that 1% of new households (76 households) under Low Growth scenario and an additional 1% of new households (80 households) under the High Growth scenario will voluntarily switch to 100% renewable electricity purchase program.

This action can be accomplished in **existing households** as follows:

Implementation unit:	10 households
Implementation units needed	33.2

Implementation Schedule for existing households

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0.25	0.25	0.25	0.25	1.0
No. units	8	8	8	8	32[182]
$MTCO_2e$	239.5	239.5	239.5	239.5	231

Upon full implementation, this action in **existing households** may offer the following savings per year.

Electricity	2,307,343 kWh	$ increase

This action can be accomplished in **new households (Low Growth)** as follows:

Implementation unit:	10 households
Implementation units needed	7.6

Implementation Schedule for new households under Low Growth scenario

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0.25	0.25	0.25	0.25	1.0
No. units	1.9	1.9	1.9	1.9	7.6
$MTCO_2e$	54.8	54.8	54.8	54.8	220

Upon full implementation, this action in **new households (Low Growth)** may offer the following savings per year.

Electricity	528,187 kWh	$ increase

This action can be accomplished in **new households (High Growth)** as follows:

Implementation unit:	10 households
Implementation units needed	8

Implementation Schedule for new households under High Growth scenario

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0	0.2	0.3	0.5	1.0
No. units	0	1.60	2.40	4.00	8
$MTCO_2e$	0	46.2	69.2	115.41	231

Upon full implementation, this action in **new households (High Growth)** may offer the following savings per year.

Electricity	555,986 kWh	$ increase

This action may result in a slight increase in annual electric utility costs per household.

Additional Considerations

A cost increase to individual consumers may detract from potential to expand Bridgeport residential participation in this program. . Nevertheless, a strategy that combines the savings from competitively supplied generation service, conservation and energy efficiency can more than offset the clean energy premium. Increased participation in this program and increased clean energy systems in the community would potentially enable the City to be eligible to receive solar panels from CCEF for public facilities. This related action could reduce City electricity costs, which would conceivably be passed indirectly to taxpayers through tax bill impact.

Connecticut Clean Energy Fund website notes that Bridgeport is a Clean Energy Community and that as of May 2010 Bridgeport has 192 Clean Energy Points.

The Mayor's Conservation Corps provides an in-place resource for promoting CTCleanEnergyOptions.

- ***Sub Action 1.7 - EID Opportunities for Large Scale Renewable Development***

Annual Savings Potential by 2030 **MTCO$_2$e not quantified**

Bridgeport's in-place Energy Improvement District (EID) can play a strategic role in developing policies and devising creative financing mechanisms to promote large-scale renewable energy development. In particular, the EID can:

Investigate resource-sharing opportunities to maximize reuse of energy byproducts from facilities located near one another;

Conduct commercial sector solid waste products analysis to determine opportunities for "waste energy" sharing and energy creation from waste products; and

Creatively finance large scale renewable development.

ACTION 2 INCREASE DISTRIBUTED GENERATION AND COMBINED HEAT AND POWER CAPACITY

- ***Sub Action 2.1 - Biomass retrofit at wastewater treatment facilities***

  Goal: Reduce fossil-fueled electricity and/or gasoline equivalents through retrofit measures at West End water treatment facility, possibly coordinating re-use of waste heat from the RESCO MSW incineration facility with re-use of treated water from the West End water treatment facility.

Annual Savings Potential by 2030 **4,921 $MTCO_2e$**

Project savings potential

4,380,000 kWh electricity[183]	1,818 $MTCO_2e$[184]
319,375 gallons gasoline equivalent	3,103 $MTCO_2e$

Implementation Summary

This action assumes retrofit measures will be undertaken at the West End water treatment facility, possibly coordinating re-use of waste heat from the RESCO municipal solid waste incineration facility with re-use of treated water from the West End water treatment facility, and also potentially including recycling of restaurant waste oils as a biomass fuel supplement at the water treatment facility.

This action can be accomplished as follows:

Implementation unit:	1 project
Implementation units needed:	1

Implementation Schedule

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0	0.1	0	0	1.0
No. units	0	1	0	0	1
$MTCO_2e$	0	4,921	0	0	4,921

Upon full implementation, this action may offer the following savings per year.[185]

Electricity	4,380,000 kWh	$ 1,051,200
Gasoline	319,375 gallons	$ 958,125

The following potential savings may be realized from this action:
$2M/year savings from eliminating hauling to New Haven and $2M per year lowered system costs[186]

Additional Considerations

Coordinated "waste products sharing", which entails using rather than losing the wastewater from the city's water treatment plant, and the excess heat from the municipal solid waste incineration facility, has great potential to make the best of both facilities, to save energy and reduce emissions. Additionally, depending upon specific technology employed, the city's water treatment facility could beneficially incorporate used cooking oils from area restaurants into operations. This measure would help turn another waste product, which currently costs money for disposal, into a usable resource.

Performing biomass retrofits at the city's water treatment facilities will create employment potential for the duration of project construction, in the building and energy trades, and possibly upon completion in water treatment operations. This Bridgeport Energy Plan does not quantify employment potential.

- ***Sub Action 2.2 - Joint action on CHP Planning***
  Goal: Define and develop feasible opportunities to reduce emissions by implementing combined heat and power and distributed generation.

Annual Savings Potential by 2030 **$MTCO_2e$ not quantified**

Energy savings and emissions not quantified. This sub-action proposes study to determine savings potential.

Implementation Summary
This action proposes joint action between Bridgeport's in-place Energy Improvement District (EID), State DECD and CDA, local business, and regional planning entities to investigate potential for reducing energy consumption and emissions by a) aggregating heating loads and b) identifying best sites for combined heat and power (CHP) and distributed energy (DE) based on proposed redevelopment and also based upon potential near Bridgeport power plant. This action also proposes exploration of the potential to receive Thermal Energy Efficiency Fund support, if associated federal legislation provides for fund establishment.

Upon implementation, this action may offer energy reduction, emissions reduction and financial savings.

Additional Considerations
This action can prove a critical first step in linking land planning and development/redevelopment to energy demand and supply and potential for reducing emissions through optimally efficient energy delivery systems.

The Connecticut Energy Advisory Board is supporting study related to CHP potential. Although it is generally believed Connecticut's large-size CHP potential has been tapped, there may very well be opportunities for smaller-site development. Several cities are beginning to require CHP evaluation as part of building construction, exceeding a certain size threshold.[187]

Large-scale retrofit projects at Bridgeport buildings should consider CHP potential. Large gas combined cycle turbines are one of the least expensive to install.

Fuel cells are another technology to consider in Bridgeport redevelopment planning. Fuel cells are generally considered more efficient in producing electricity than many other CHP technologies and have lower emissions, but also have higher capital costs. [188] *The CEAB reports fuel cells are a good fit for distributed generation CHP applications due to the large release of heat related to their operation, and notes efficiencies upwards of 90 percent may result from their use in this manner.*[189] *Connecticut, unlike many other states, considers fuel cells as a renewable energy source under its Renewable Portfolio Standard guidelines.*

Several major cities, including London and Copenhagen, have embraced DG and CHP in recent or relatively recent timeframes with extremely favorable emissions reduction results. Nearly 60 percent of Denmark's electricity is coproduced with heat, and over 97 percent of Copenhagen's 35,000 buildings do not have a boiler or smokestack owing to district heat, which is delivered through 800 miles of underground piping. Eighteen years' time and $562 million created most of the system. More recently, London has begun to invest $7.5-10.5 billion in infrastructure to supply a quarter of its energy demand from decentralized sources by 2020.[190]

At the federal level, discussions are ongoing to create a Thermal Energy Fund, supported by proceeds from the auction of two percent of carbon emission allowances, which would be made available to entities, including local governments, to finance district heat energy, CHP, and recoverable waste energy projects. Related action would formally establish a goal for combined heat and power of 20 percent or more of total U.S. electrical power capacity.[191] *Short-term planning, on Bridgeport's part, can well position the City for longer-term opportunities.*

ACTION 3 RESIDENTIAL AND COMMERCIAL SOLAR ENERGY

- ***Sub Action 3.1 - Solar pv on flat-roof residential buildings***
  Goal: Meet one third of electricity demand per building[192] at 15% of flat-roof residential buildings through on-site solar systems.

Annual Savings Potential by 2030 **279 $MTCO_2e$**

Per household savings potential

4,800 kWh electricity[193] 2 $MTCO_2e$[194]

Implementation Summary

This action assumes installation of a 4 KW solar PV system on15% of the city's 934[195] flat-roof residential buildings, or 140 buildings.

This action can be accomplished as follows:

Implementation unit: 10 buildings

Implementation units needed: 14

Implementation Schedule

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0.1	0.3	0.4	0.2	1.0
No. units	1	4	6	3	14
$MTCO_2e$	28	84	112	56	279

Upon full implementation, this action may offer the following savings per year.[196]

Electricity	672,000 kWh	$161,300

This action may result in average annual savings per building of $1,152, but savings would be offset, in part, by system installation cost.

Additional Considerations

The majority of solar installation phase-in in this Energy Plan is deferred to the 2015-2020 and 2020-2025 time periods. The Connecticut Energy Advisory Board (CEAB) notes costs of solar pv systems are relatively high, compared with other energy- and emissions- saving measures, particularly conservation and efficiency. CEAB notes solar installation costs are decreasing, and are expected to continue to decrease, making slight delay in implementation potentially more worthwhile financially.[197]

The City of Bridgeport is evaluating responses to an RFP for multi-site solar development potential of more than 20 MW installed capacity, and possible power purchase agreement opportunities. The Bridgeport Energy Improvement District may be able to participate in solar development and financing options.

Connecticut, through its Connecticut Clean Energy Fund, has a solar incentive program in place, but oversubscription periodically reduces fund availability.

Solar PV installed on residential flat roof properties is estimated to create job potential for 7.28 fulltime equivalent work years.[198]

- ***Sub Action 3.2 - Solar pv on pitched roof residential buildings***
  Goal: Meet one third of electricity demand per building[199] at 10% of pitched roof residential buildings through on-site solar systems.

Annual Savings Potential by 2030 **4,370 $MTCO_2e$**

Per household savings potential

4,800 kWh electricity[200]	2 $MTCO_2e$

Implementation Summary

This action assumes installation of a 4 KW solar PV system on 10% of the city's 21,932 pitched roof residential buildings, or 2,193 buildings.

This action can be accomplished as follows:

Implementation unit:	10 buildings
Implementation units needed:	219.3

Implementation Schedule

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0.1	0.3	0.4	0.2	1.0
No. units	22	66	88	44	220[201]
$MTCO_2e$	437	1,311	1,748	874	4,370

Upon full implementation, this action may offer the following savings per year.[202]

Electricity	10,526,400 kWh	$2,526,300

This action may result in average annual savings per building of $1,152.

Additional Considerations

The majority of solar installation phase-in is deferred to the 2015-2020 and 2020-2025 time periods. The Connecticut Energy Advisory Board (CEAB) notes costs of solar pv systems are relatively high, compared with other energy- and emissions- saving measures, particularly conservation and efficiency. CEAB notes solar installation costs are decreasing, and are expected to continue to decrease, making slight delay in implementation potentially more worthwhile financially.[203]

The City of Bridgeport is evaluating responses to an RFP for multi-site solar development and possible power purchase agreement opportunities. The Bridgeport Energy Improvement District may be able to participate in solar development and financing options.

Connecticut, through its Connecticut Clean Energy Fund, has a solar incentive program in place, but oversubscription may reduce fund availability.

Installation of solar PV on pitched roof residential buildings is estimated to create job potential for* 114 *fulltime equivalent work years.[204]

- ***Sub Action 3.3 - Solar thermal on pitched roof residential buildings***
  Goal: Meet 70% of hot water needs per building[205] at 15% of the city's 21,932 pitched roof residential buildings[206] through on-site solar thermal systems.

Annual Savings Potential by 2030 **9,170 $MTCO_2e$**

Per household savings potential

22.02 thousand cf natural gas[207]	1.3 $MTCO_2e$[208]
0.162 thousand gallons heating oil	1.5 $MTCO_2e$

Implementation Summary

This action assumes installation of 3-collector solar thermal systems on 3,290 pitched roof residential buildings[209].

This action can be accomplished as follows:

Implementation unit:	10 buildings
Implementation units needed:	329

Implementation Schedule

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0.2	0.3	0.4	0.1	1.0
No. units	66	99	132	33	329
$MTCO_2e$	1,834	2,751	3,668	917	9,170

Upon full implementation, this action may offer the following savings per year.[210]

Natural Gas	72,437 thousand cf	$ 1,072,800
Light fuel oil	532 thousand gallons	$ 1,409,800

This action may result in average annual savings per building of approximately $750.

Additional considerations

The majority of solar installation phase-in is deferred to the 2015-2020 and 2020-2025 time periods. The Connecticut Energy Advisory Board (CEAB) notes costs of solar pv systems are relatively high, compared with other energy- and emissions- saving measures, particularly conservation and efficiency. CEAB notes solar installation costs are decreasing, and are expected to continue to decrease, making slight delay in implementation potentially more worthwhile financially.[211]

The City of Bridgeport is evaluating responses to an RFP for multi-site solar development and possible power purchase agreement opportunities. The Bridgeport Energy Improvement District may be able to participate in solar thermal development and financing options.

Connecticut, through its Connecticut Clean Energy Fund, has a solar thermal incentive program in place, but oversubscription may reduce fund availability.

Solar thermal installation is less expensive than solar PV system installation. Some parts of Hawaii require solar thermal installation on new construction.

Solar thermal installation on pitched roof residential buildings is estimated to create job potential for 118 fulltime equivalent work years.[212]

- ***Sub Action 3.4 - Solar pv on existing flat roof commercial buildings***

Goal: Reduce electricity-related emissions by 20% per building at 30% of the city's 1,532 existing flat roof commercial buildings through on-site solar PV systems.[213]

Annual Savings Potential by 2030 **16,663 $MTCO_2e$**

Per building savings potential

87,258 kWh electricity[214] 36.2 $MTCO_2e$[215]

Implementation Summary

This action assumes installation of 73 KW (average size)[216] on-site solar PV system at 460 existing flat roof commercial buildings.

This action can be accomplished as follows:

Implementation unit:	10 buildings
Implementation units needed:	46

Implementation Schedule

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0.1	0.3	0.4	0.2	1.0
No. units	5	14	18	9	46
$MTCO_2e$	1,666	4,999	6,665	3,333	16,663

Upon full implementation, this action may offer the following savings per year.[217]

Electricity	40,138,487 kWh	$9,633,200

This action may result in average annual savings per building of $20,900.

Additional Considerations

The majority of solar installation phase-in is deferred to the 2015-2020 and 2020-2025 time periods. The Connecticut Energy Advisory Board (CEAB) notes costs of solar pv systems are relatively high, compared with other energy- and emissions- saving measures, particularly conservation and efficiency. CEAB notes solar installation costs are decreasing, and are expected to continue to decrease, making slight delay in implementation potentially more worthwhile financially.[218]

The City of Bridgeport is evaluating responses to an RFP for multi-site solar development and possible power purchase agreement opportunities. The Bridgeport Energy Improvement District may be able to participate in solar development and financing options.

Connecticut, through its Connecticut Clean Energy Fund, has a solar incentive program in place, but oversubscription may reduce fund availability.

One of the concerns to be addressed is the competing need for roof space for solar systems and green roofs. In fact, solar/green roof combinations can have many benefits. By reducing roof temperatures, green roofs enable more efficient operation of solar systems. The Energy Improvement District can serve Bridgeport businesses well by preparing at least a rough analysis that defines the optimal mix of these two opportunities so that commercial property owners have, at minimum, a general guide from which to make an investment decision relative to the merits of each singularly and combined.

Installation of Solar PV on existing flat roof commercial buildings is estimated to create job potential for 276 fulltime equivalent work years.[219]

- ***Sub Action 3.5 - Solar pv on pitched roof commercial buildings***
  Goal: Reduce electricity emissions by 24% per building at 5% of the city's 915 pitched roof commercial buildings.[220]

Annual Savings Potential by 2030 **1,015 $MTCO_2e$**

Per building savings potential

54,358 kWh electricity[221] 22.6 $MTCO_2e$[222]

Implementation Summary

This action assumes installation of 45 KW (average size)[223] on-site solar PV system at 45 existing pitched roof commercial buildings

This action can be accomplished as follows:

Implementation unit: 10 buildings

Implementation units needed: 4.5

Implementation Schedule

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0.1	0.3	0.4	0.2	1.0
No. units	0.45	1.35	2	1	4.5
$MTCO_2e$	102	305	406	203	1,015

Upon full implementation, this action may offer the following savings per year.[224]

Electricity 611,524 kWh $146,800

This action may result in average annual savings per building of $3,260.

Additional Considerations

The majority of solar installation phase-in is deferred to the 2015-2020 and 2020-2025 time periods. The Connecticut Energy Advisory Board (CEAB) notes costs of solar pv systems are relatively high, compared with other energy- and emissions- saving measures, particularly conservation and efficiency. CEAB notes solar installation costs are decreasing, and are expected to continue to decrease, making slight delay in implementation potentially more worthwhile financially.[225]

The City of Bridgeport is evaluating responses to an RFP for multi-site solar development and possible power purchase agreement opportunities. The Bridgeport Energy Improvement District may be able to participate in solar development and financing options.

Connecticut, through its Connecticut Clean Energy Fund, has a solar incentive program in place, but oversubscription may reduce fund availability.

Installation of Solar PV on pitched roof commercial buildings is estimated to create job potential for 27 fulltime equivalent work years.[226]

- ***Sub Action 3.6 - Solar pv on new flat roof commercial buildings under Low Growth scenario***
- ***Sub Action 3.7 - Solar pv on additional new flat roof commercial buildings under High Growth scenario***
  Goal: Reduce electricity-related emissions by 20% per building through solar system installation on 15% of new commercial buildings.[227]

Annual Savings Potential by 2030 (Low Growth)	**1,232 $MTCO_2e$**
Additional Annual Savings Potential by 2030 (High Growth)	**1,051 $MTCO_2e$**

Per building savings potential

87,258 kWh electricity[228] 36.2 $MTCO_2e$[229]

Implementation Summary

- **Sub Action 3.6 and Sub Action 3.7**

This action assumes installation of 73 KW (average) solar PV on 34 new commercial buildings under Low Growth Scenario and 29 additional new buildings under the High Growth scenario.

- **Sub Action 3.6 (Low Growth) can be accomplished as follows:**

Implementation unit: 10 buildings
Implementation units needed: 3.5

Implementation Schedule

2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total

Percent	0.25	0.25	0.25	0.25	1.0
No. units	0.85	0.85	0.85	0.85	3.5
$MTCO_2e$	308	308	308	308	1,232

Upon full implementation, this action may offer the following savings per year.[230]

Electricity	2,966,758 kWh	$712,000

- **Sub Action 3.7 (High Growth) can be accomplished as follows:**

Implementation unit: 10 buildings
Implementation units needed: 2.9

Implementation Schedule

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0	0.2	0.4	0.4	1.0
No. units	0	0.58	1.16	1.16	2.9[231]
$MTCO_2e$	0	210	420	420	1,051

Upon full implementation, this action may offer the following savings per year.[232]

Electricity	2,530,470 kW	$607,300

Each of these actions may result in average annual savings per building of $20,940.

Additional Considerations

The majority of solar installation phase-in is deferred to the 2015-2020 and 2020-2025 time periods. The Connecticut Energy Advisory Board (CEAB) notes costs of solar pv systems are relatively high, compared with other energy- and emissions- saving measures, particularly conservation and efficiency. CEAB notes solar installation costs are decreasing, and are expected to continue to decrease, making slight delay in implementation potentially more worthwhile financially.[233]

The City of Bridgeport is evaluating responses to an RFP for multi-site solar development and possible power purchase agreement opportunities. The Bridgeport Energy Improvement District may be able to participate in solar development and financing options.

Connecticut, through its Connecticut Clean Energy Fund, has a solar incentive program in place, but oversubscription may reduce fund availability.

Installation of solar PV on new flat roof commercial buildings under Low Growth scenario is estimated to create job potential for* 20.4 *fulltime equivalent work years.

Installation of Solar PV on new flat roof commercial buildings under High Growth scenario is estimated to create job potential for* 17.4 *fulltime equivalent work years.

- ***Sub Action 3.8 - EID Opportunities for On-site Renewable Development***
  Goal: Capitalize on the EID's unique capabilities to support renewable energy development.

Annual Savings Potential by 2030 **$MTCO_2e$ not quantified**

Implementation Summary and Considerations

Bridgeport's existing Energy Improvement District may play a critical leadership role in forwarding the City of Bridgeport's efforts to establish on-site renewable energy systems. The City is currently evaluating submissions related to the creation of scattered-site solar PV on 183 acres in Bridgeport's Downtown. The EID's bonding capacity, and unique organizational structure, enable it to lend financial and other assistance to the process of aggregating the power potential of scattered on-site renewable installations and developing power supply relationships with generation partners. The EID may use its own financial capacity to great effect to leverage other existing funds to support renewable energy development in Bridgeport.

The EID should look to other municipalities, which have demonstrated visible and effective investment in development of solar, solar thermal, and associated green roof installations as models for maximizing its ability to establish renewable energy in Bridgeport.

ACTION 4 UTILITY SCALE POLICIES AND PROGRAMS FOR REGIONAL RENEWABLE ENERGY DEVELOPMENT

Goal: Reduce emissions though utility-scale policies and programs, which develop increased renewable capacity for electricity generation.

Annual Savings Potential by 2030 **$MTCO_2e$ not quantified**

Implementation Summary and Considerations

Connecticut energy distributors are working closely with others in New England to develop the best roadmap for developing renewable energy. New England Governors have joined together to support this regional renewable initiative through their New England Governor's 2009 Renewable Blueprint initiative.[234] Connecticut's Renewable Portfolio Standard is the most stringent in the region, and recent analysis suggests Connecticut cannot meet its RPS in a cost effective manner via in-state renewable resources. Procurement through the New England regional market is currently viewed as Connecticut's preferred strategy for meeting its RPS. Regionally, onshore wind is viewed as the most favorable renewable fuel source. High transmission infrastructure costs associated with this type of capacity expansion are still expected to be less than the cost of on-site renewable development in state.[235] The Connecticut Energy Advisory Board reports the most

economic mix of renewable resources for the New England region is 42 percent wind, 35 percent biomass, 10 percent offshore wind, 6 percent solar, 3 percent hydro, 2 percent landfill gas, and 2 percent fuel cells by energy. [236] How New England develops and distributes renewable energy will impact future emissions associated with energy use in Bridgeport. Furthermore, how the Connecticut governing bodies allocate funds associated with renewable energy and energy and efficiency programs will critically impact renewable energy development and emissions in Bridgeport as well as all state municipalities.

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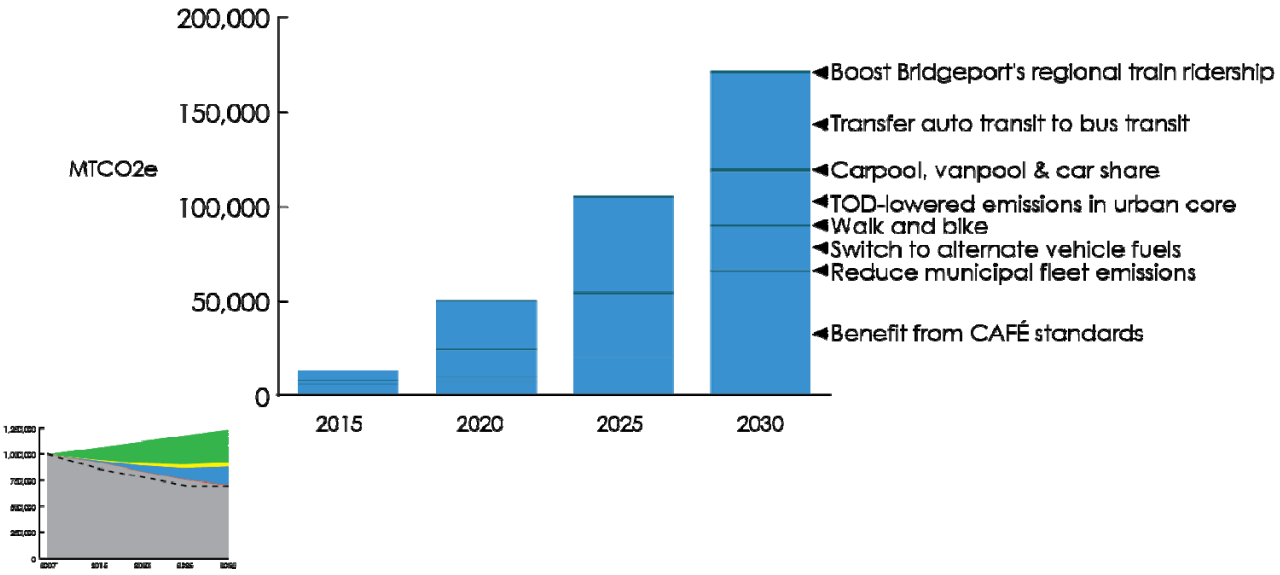
LAND USE AND TRANSPORTATION

SUMMARY

9.4% of total reduction 2010 to 2015

30.9% of cumulative reduction by 2030

Land Use and Transportation		$MTCO_2e$
Action 1	Boost Bridgeport's Regional Train Ridership	590
Action 2	Transfer auto transit to bus transit	50,334
Action 3	Carpool, vanpool and car share options	1,499
Action 4	TOD-lowered emissions in urban core	28,096
Of note	*Transit oriented development*	*626,579*
Action 5	Walking and biking	246
Action 6	Reduce municipal fleet emissions	532
Action 7	Switch to alternate vehicle fuels	23,312
Action 8	Higher fuel efficiency community-wide through CAFÉ standards	**65,515**
	Annual Emissions Reduction by Full Implementation 2030	**170,124**



SAVINGS (annual by full implementation)	
Electricity	**- $0.36 million**
Gasoline/diesel	**$ 53.7 million**
GAINS	
Vehicle miles equivalent fuel reduction	**714 million**
Fulltime equivalent work-years	**10**

Narrative Summary

- Plan action items related to land use and transportation are estimated to have savings potential of $53 million in energy costs a year, upon full implementation. Emissions reduction is the equivalent of roughly 715 million VMT a year.

- Land use and transportation are intertwined in their impact on carbon emissions. Bridgeport's greatest opportunity to effect *regional* emissions reductions is to redevelop. Households, employment centers, cultural and entertainment venues can be located close to the City's urban core and public transit. Recently-revised zoning enables this. Bridgeport emissions will increase from additional in-use structures, but emissions to the region may be avoided if development occurs "in-city" in place of sprawled development.

- 6,000 new households in the urban core will create lower net energy demand and emissions increases than suburban development, owing to more energy-efficient urban form and potential for reduced dependence on automobile usage.

- Along with "in-city" housing must come support services to decrease reliance on the automobile. These include expanded bus service, shuttle vans to job sites and mechanisms for developing carpools and car share and/or bike share programs.

- An easy opportunity to reduce transportation emissions is to transfer work and non-work trips under 1-mile immediately from automobile VMT to walk or bike VMT. Outreach will be needed to encourage this shift. Schools can play a vital role in bringing students to neighborhood schools in walking or bicycling groups in place of automobiles.

- Flat topography in the City's southern section makes Bridgeport easily-bikeable, and the streets can be made even more bike and pedestrian-friendly through "Complete Streets" development, which is in its nascent stage, under City-direction.

- Beyond Bridgeport's control are the several hundred thousand vehicles that pass through the City on interstate highways daily. Emissions from vehicles passing through the City will be reduced over time as Federal CAFÉ standards prompt more fuel efficient cars and light trucks. Certain reductions will also occur as alternate fueled vehicles begin to enter the market. Connecticut's Electric Vehicles Infrastructure Council (CEVIC) is currently targeting Connecticut for PEV development, although overall market penetration will likely be small.[237]

- Also beyond Bridgeport's immediate control is investment in transit. Such investment must continue as part of State and regional smart growth, transport, economic development, and environmental health strategies. Transit alternatives must be provided to reduce single occupancy vehicle travel, congestion, and poor air quality days, and to enable expanded opportunity to the job market for those unable to afford cars.

- In relation to Green Buildings and Renewable Energy, Transportation and Land Use strategies offer fewer direct job opportunities, but many indirect job opportunities and economic development openings result.

ACTION 1 BOOST BRIDGEPORT'S REGIONAL TRAIN RIDERSHIP

- ***Sub Action 1.1 - Shift workday travel from roadway to train***
  Goal: Transfer 10,000 vehicle miles of work-related travel per year from roadway to train for Bridgeport start point or end point.

Annual Savings Potential by 2030 **258 $MTCO_2e$**

Per person (single driver) savings potential[238]

-878 KWh electricity	-0.4 $MTCO_2e$[239]
64.05 gallons gasoline	0.6 $MTCO_2e$
Total	0.3 $MTCO_2e$

1,000 VMT reduction

Implementation Summary

This action assumes 1,000 persons will transfer work-related travel, averaging 4-miles round trip to Bridgeport start points or end points, from roadway to train.[240]

This action can be accomplished as follows:

Implementation unit:	20 persons (drivers)
Implementation units needed:	50

Implementation Schedule

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0.2	0.3	0.3	0.2	1.0
No. units	10	15	15	10	50
$MTCO_2e$	52	77	77	52	258

Upon full implementation, this action may offer the following savings per year.[241]

Electricity	-878077.4557 kWh i*ncrease*	-$210,700
Gasoline	64, 051 gallons	$192,200

This action may result in annual average savings per person of $192 for gasoline for travel in Bridgeport alone. More gasoline savings may be realized for continued travel beyond Bridgeport. Gasoline savings would be offset in part by transit costs.

Additional Considerations

Redevelopment in Bridgeport's downtown core will open up opportunities for increased train ridership into the city by employees from neighboring towns and out of the city by new residents. Train ridership is usually cost-effective to riders, particularly when considering the cost of automobile insurance and maintenance, but a shift to train ridership faces the real or perceived barrier of longer commute time, inconvenience and lack of parking opportunity in surrounding town train stations. It will be important to market the cost benefits of train ridership and also to ensure suitable transfers are available, if needed. Further, opportunities to park at, or otherwise access, neighboring commuter train stops, to enable train ridership into Bridgeport, must be addressed at local, regional and state levels.

Train ridership can provide household savings, improved air quality, reduced congestion on roadways, access to jobs for persons who do not own a car, and, in some cases, increased physical activity associated with walking to train stops.

The American Public Transportation Association finds that households with two workers, one car and access to transit can save over $6,000 a year.[242]

Employment potential for this action was not quantified.

- ***Sub Action 1.2 - Increase shuttle van service from transit center to employment centers to promote train ridership***
  Goal: Transfer 1,000,000 vehicle miles of automobile travel to train travel by establishing 20 shuttle vans to promote train ridership by 720 persons working, visiting, or attending school in Bridgeport.

Annual Savings Potential by 2030 **332 $MTCO_2e$**

Savings potential per shuttle van (serves 36 persons with multiple trips)

kWh electricity	-31,611[243]	-13.1 $MTCO_2e$[244]
Gallons gasoline	3,059	29.7 $MTCO_2e$
Total emissions savings		16.6 $MTCO_2e$

1,000,000 VMT reduction per van

Implementation Summary

This action assumes 20 new shuttle vans will be established to transport 720 workers, students and/or visitors to and from the train station and will promote train ridership as a result.

This action can be accomplished as follows:

Implementation unit:	4 shuttle vans
Implementation units needed:	5

Implementation Schedule

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0.1	0.3	0.3	0.3	1.0
No. units	0.5	1.50	1.50	1.50	5
$MTCO_2e$	33	100	100	100	332

Upon full implementation, this action may offer the following savings per year.[245]

Electricity	-632,218 kWh	-$151,732
Gasoline	61,176 gallons	$183,500

This action may result in annual average savings per person of $192 for gasoline, which would be offset in part by transit costs, but would be supported by reduced personal automobile maintenance costs.[246]

Additional Considerations

Several Bridgeport employers currently provide shuttle service between the train station and work locations. Additional employers must partner in this effort. The Bridgeport Regional Business Council and City of Bridgeport can, together, act as leaders in promoting the increase in van service. Bridgeport's EID can help focus study on additional businesses that may have shuttle van opportunities.

Similar to any effort aimed at increasing train ridership, this action item faces real or perceived barriers associated with train travel, including longer commute time, inconvenience and lack of parking opportunity in surrounding town train stations. It will be important to market the cost benefits of train ridership. Further, opportunities to park at, or otherwise access, neighboring commuter train stops, to enable train ridership into Bridgeport, must be addressed at local, regional and state levels.

Train ridership can provide household savings, improved air quality, reduced congestion on roadways, access to jobs for persons who do not own a car, and, in some cases, increased physical activity associated with walking to train stops.

Some municipalities are creating incentives for transit ridership over personal auto travel through both direct transit incentives and parking disincentives.

Although transporting riders short distances, the value of shuttle van service will be apparent in cumulative VMT reduction, reduced congestion and quality of street life in Bridgeport's inner core.

Increased shuttle van service is estimated to create job potential for 10 fulltime equivalent work years.[247]

ACTION 2 TRANSFER AUTO TRANSIT TO BUS TRANSIT

- ***Sub Action 2.1 - Shift Automobile Transit to Bus Transit***
  Goal: Transfer 1,188,000 vehicle miles of work-related travel per year from roadway to bus for Bridgeport start point or end point.[248]

Annual Savings Potential by 2030 **1,452 $MTCO_2e$**

Per person (driver) savings potential[249]

243 gallons gasoline	2.4 $MTCO_2e$
1,980 VMT reduction per person	

Implementation Summary

This action assumes 600 persons will shift from single occupancy automobile travel to bus travel for work-related trips starting or ending in Bridgeport.

This action can be accomplished as follows:

Implementation unit:	10 persons (drivers)
Implementation units needed:	60

Implementation Schedule

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0.25	0.25	0.25	0.25	1.0
No. Units	15	15	15	15	60
$MTCO_2e$	363	363	363	363	1,452

Upon full implementation, this action may offer the following savings per year.[250]

Gasoline	145,800 gallons	$437,400
Total VMT reduction	1,188,000	

This action may result in annual average savings per person of $288 for gasoline. This would be offset in part by transit costs, but might also be supported by decreased personal automobile maintenance costs.[251]

Additional Considerations

Expanded service within Bridgeport is necessary to reduce SOV miles travelled. Additional buses are needed to supply appropriate time-of-day service. Lack of an appropriate bus maintenance facility is a current barrier to expanding the existing fleet and providing additional service. This must be addressed through State and Federal Action and funding.

Bridgeport bus transit receives less funding support than other state bus service. Opportunities to support fare box funds with increased outside funding is a critical need.

A two-way outreach and analysis must occur between Greater Bridgeport Transit and the employment community, in particular, but also the residential community, to determine precisely where service gaps exist and to define ways in which service may best be developed so that additional automobile drivers voluntarily shift automobile vehicle miles to bus miles.

Working together, Greater Bridgeport Transit, Bridgeport Regional Business Council, and the City of Bridgeport can develop an aggressive outreach program to provide ecopasses (single price passes for unlimited rides) to as many major employers as possible for their employees.[252]

Cost savings of transit ridership is a built-in incentive to bus ridership, but barriers or perceived barriers related to extra travel time, added wait time, safety and convenience, must be overcome.

Employment potential associated with a shift of ridership from automobile to bus was not quantified by this energy plan.

- ***Sub Action 2.2* - Create BRT to shift 40,000,000 VMT as expressway "thru" miles**
  Goal: Shift 40,000,000 VMT of "thru transit" on Bridgeport expressways to bus/BRT.

Annual Savings Potential by 2030 **48,882 $MTCO_2e$**

Savings potential[253] per 5-mile trip

0.61 gallons gasoline[254] 0.001 $MTCO_2e$

5 mile VMT reduction per trip

Implementation Summary

This action assumes bus transit will be developed to accommodate approximately 5% of expected 715 million annual VMT in 2030 and transfer 22,000 vehicles per day traveling "thru" Bridgeport on I-95 and Route 8/25 to bus transit.[255]

This action can be accomplished as follows:

Implementation unit:	5% shift in ridership from SOV to BRT
Implementation units needed:	20

Implementation Schedule

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0.1	0.4	0.5	0	1.0
No. units	2	8	10	0	20
$MTCO_2e$	4,888	19,553	24,441 0	0	48,882

Upon full implementation, this action may offer the following savings per year.[256]

Gasoline	4,913,805 gallons	$14,741,400
Total VMT reduction	40,000,000	

Additional Considerations

A significant number of vehicle miles travelled within Bridgeport, and counted toward Bridgeport's GHG Inventory, are associated with travel "thru" Bridgeport and require regional and state action to reduce. Increased transit service, to reduce "thru" miles may be provided through Bus Rapid Transit and/or train ridership. Successful completion of this action requires State-level leadership and action.

A reduction of 40,000,000 VMT represents approximately 5% of the projected 715 Million VMT expected under the High Growth scenario.[257] Assuming this mileage is divided 50% I-95 thru traffic and 50% Route 8/25 "thru" traffic, over 22,000 automobile trips could be eliminated each day.

Employment opportunities associated with this measure are anticipated, but were not quantified by this energy plan.

ACTION 3 TRANSFER SOV VMT TO CARPOOL, VANPOOL AND CAR SHARE OPTIONS

- ***Sub Action 3.1 - Establish carpools to accommodate 400 riders on work-related trips***
  Goal: Achieve 720,000 VMT reduction by replacing single occupancy automobile trips with carpools.

Annual Savings Potential by 2030 **448 $MTCO_2e$**

Savings potential per car pool

115 gallons gasoline[258] 1.1 $MTCO_2e$[259]

1,800 VMT reduction per car pool

Implementation Summary

This action assumes 400 drivers will switch from single driver vehicles to carpools for work-related trips with Bridgeport start or end point.

This action can be accomplished as follows:

Implementation unit: 5 car pools

Implementation units needed: 80

Implementation Schedule

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0.2	0.3	0.3	0.2	1.0
No. units	16	24	24	16	80
$MTCO_2e$	90	134	134	90	448

Upon full implementation, this action may offer the following savings per year.[260]

Gasoline 46,117 gallons $138,400

Total VMT reduction: 720,000

This action may result in annual average savings per person of $157 for gasoline for miles travelled in Bridgeport.[261] This would be supported by decreased personal automobile maintenance costs as well as by savings that might result from carpooled miles, which are part of these trips, but are travelled beyond Bridgeport.

Additional Considerations

The City of Bridgeport can take a leadership role in demonstrating the potential for carpooling, as well as other green travel methods. Programs such as NuRide can provide participants rewards for participation.

The Bridgeport Regional Business Council can support City efforts through outreach to local employers. Many businesses and employees may be unfamiliar with possible carpool rewards programs.

MetroPool has shown some success in helping regional employers to establish SOV-alternatives, and may be able to expand outreach specifically to Bridgeport employers.

Benefits of carpooling, in terms of energy and emissions reductions, would realistically be greater than what is quantified in this Energy Plan since car pool travel would likely originate or end beyond Bridgeport boundaries and include greater distance travelled than the "in-Bridgeport" miles. Savings reported in this Energy Plan only relate to VMT within Bridgeport, to allow consistency with GHG inventory protocol and Bridgeport's 2007 GHG Inventory.

Indirect employment opportunities only may be associated with this action.

- ***Sub Action 3.2* - Transfer Single Occupancy VMT to vanpool VMT**
  Goal: Achieve 105,000 VMT reduction by establishing vanpools at Bridgeport employment hubs.

Annual Savings Potential by 2030	**65 $MTCO_2e$**

Savings potential per vanpool[262]

673 gallons gasoline	6.5 $MTCO_2e$[263]

Implementation Summary

This action assumes vanpools will be established by 10 Bridgeport employment hubs to serve 80 persons on work-related travel.

This action can be accomplished as follows:

Implementation unit:	2 van pools
Implementation units needed:	5

Implementation Schedule

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0.25	0.25	0.25	0.25	1.0
No. units	1.25	1.25	1.25	1.25	5
$MTCO_2e$	16	16	16	16	65[264]

Upon full implementation, this action may offer the following savings per year.[265]

Gasoline	6,725 gallons	$20,200

This action may result in annual average savings per 8-person van of $2,000 for gasoline for miles travelled in Bridgeport. This would be offset by van-ridership costs, but supported by decreased personal automobile maintenance costs and savings that will likely result from miles that are part of these trips, but are travelled beyond Bridgeport.

Additional Considerations

EasyStreet is Connecticut's statewide commuter vanpool service, sponsored by the Connecticut Department of Transportation, which enables 8-15 workers to travel to work together in an Easy Street® van.

The city of Bridgeport and the Bridgeport Regional Business Council can look to both the EasyStreet opportunity and other successful in-place vanpool programs in developing outreach to gain similar vanpools in other places of employment.

Upon full implementation, this action may create slight direct employment potential.

- ***Sub Action 3.3 - Establish car share opportunities in Bridgeport***
  Goal: Achieve 1,584,842 VMT reduction by creating car share opportunities in Bridgeport.

Annual Savings Potential by 2030 **986 $MTCO_2e$**

Savings potential per shared car[266]

4,306 gallons gasoline[267] 49 $MTCO_2e$[268]

Implementation Summary

This action assumes 20-shared cars will be established to serve 874 persons and reduce vehicle miles travelled and congestion.

This action can be accomplished as follows:

Implementation unit:	1 shared car
Implementation units needed:	20

Implementation Schedule

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0.25	0.25	0.25	0.25	1.0
No. units	5	5	5	5	20
$MTCO_2e$	247	247	247	247	986

Upon full implementation, this action may offer the following savings per year.[269]

Gasoline	86,133 gallons	$258,400
Total VMT reduction	1,584,842	

This action may result in annual average savings per person of $295 for gasoline, but would be offset, in part by cost of carshare program membership.

Additional Considerations

Car sharing is a membership program that offers access to a fleet of cars on an hourly basis. Carsharing is designed for short-term, intermittent trips, more so than daily commutes to work. Several municipalities, including Philadelphia, are shifting their fleets to carshare as a cost saving measure. Philadelphia expects to replace 75 of its municipal fleet cars with 3 Philly CarShare vehicles at a savings of over $5 Million over 5 years. In Chicago, it is estimated that carshare members can save $4,000 to $6,000 per year in transportation costs (as estimated by ZipCar, one carshare operation). CarSharing appears to have an added benefit of changing carshare members' driving behavior toward reduced vehicle miles travelled. [270]

The City of Bridgeport must investigate carsharing opportunities as a means of reducing its fleet operations and maintenance costs. It may wish to do so in conjunction with a parallel public program. As increased infill establishes more residential use in Downtown, existing mass transit may serve the majority of transportation needs, but carsharing may very well meet the need for occasional travel beyond the city, and eliminate the need for added car ownership.

This action may have indirect employment opportunities associated with its implementation.

ACTION 4 PROMOTE TRANSIT ORIENTED DEVELOPMENT

- ***Sub Action 4.1 - Promote Transit Oriented Development to enable 10,000 new housing units within Bridgeport's urban core.***
  Goal: enable 62% lower net increase in travel emissions by 27,000 persons and VMT reduction of 45,154,260 relative to travel related to new housing beyond the urban core.[271]

Annual Savings Potential by 2030 **28,096 $MTCO_2e$**

Per household savings potential

289 gallons gasoline[272] 2.8 $MTCO_2e$[273]
4,515-vehicle mile reduction per household

Implementation Summary
This action assumes 10,000 new households will be created in Bridgeport's urban core, close to transit and employment opportunities.

Implementation unit:	10 households
Implementation units needed:	1,000

Implementation Schedule

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0.25	0.25	0.25	0.25	1.0
No. units	250	250	250	250	1,000
$MTCO_2e$	7,024	7,024	7,024	7,024	28,096

Upon full implementation, this action may offer the following savings per year.[274]

Gasoline	2,892,218 gallons	$8,676,700

This action may result in annual average savings per household of $860 for gasoline.

Additional Considerations
Residents in "smart growth" communities often enjoy cost savings over residents in more sprawled communities due to decreased energy costs and less reliance on automobiles. Chicago metropolitan households in transit-served neighborhoods, for example, pay 15% of their income for transportation, as opposed to 23% in households located in communities with no transit.[275]

Demand for TOD is rising with more households seeking to live close to commercial and entertainment amenities. One source estimates the demand for housing near transit will reach 9 million households nationally by 2020.[276] Added benefits of "smart growth" development are decreased vehicle miles traveled, improved air quality, reduced congestion, increased physical activity associated with walking to transit, and increased access to jobs.

Transit is estimated to return $6 to a region for every $1 investment.[277]

Recent zoning changes in Bridgeport enable added mixed-use development Downtown. Creating a second train station represents untapped potential for additional TOD in the eastern half of the city. This action requires Federal and State support.

Employment opportunity associated with this action was not quantified by this energy plan.

- ***Sub Action 4.2 - Emissions avoidance by creating mixed-use development within Bridgeport's urban core***

626,579 metric tons CO_2e of transportation-related emissions may to be avoided by creating housing units within Bridgeport's urban core.[278] This item is included for informational purposes only. Emissions reduction associated with this action is not numerically included in Bridgeport's carbon reduction plan.

This estimate of emissions avoidance is the result of modeling done for a neighboring urban center, which assumed development of 6,113 new households in the urban center versus an equal number of new households in adjoining suburban locations.

Annual Savings Potential by 2030		*Potential for avoided emissions **626,579** **$MTCO_2e$*** *For informational purposes only; savings are not counted toward reduction goal*
Total VMT reduction[279]	*111,064,781 miles*	
Gasoline savings[280]	*389 gallons*	
Emissions savings		*626,579* $MTCO_2e$

Additional Considerations

Demand for TOD is rising with more households seeking to live close to commercial and entertainment amenities. One source estimates the demand for housing near transit will reach 9 million households nationally by 2020.[281]

Added benefits of "smart growth" development are decreased vehicle miles traveled, improved air quality, reduced congestion, increased physical activity associated with walking to transit, and increased access to jobs.

Recent zoning changes in Bridgeport enable added mixed-use development Downtown. Creating a second train station represents untapped potential for additional TOD in the eastern half of the city. This action requires Federal- and State-level support.

Employment opportunity associated with this action was not quantified by this energy plan.

ACTION 5 REPLACE AUTOMOBILE TRIPS WITH WALKING OR BICYCLE TRIPS

- ***Sub Action 5.1 - Transfer in-city work trips from automobile travel to walk or bike trips under 1 mile***
- ***Sub Action 5.2 - Transfer in-city non-work trips from automobile travel to walk or bike trips under 2 mil***

Goal: Reduce automobile VMT by 125,265 miles by transferring 35% of citywide work trips within 1 mile of destination to walk or bike trips and reduce automobile VMT by an additional 339,585 VMT by transferring 24% of citywide non-work trips within 1 mile of destination to walk or bike trips.[282]

Annual Savings Potential by 2030 (In-city walk trips under 1 mile)	**106 $MTCO_2e$**
Additional Annual Savings Potential by 2030 (In-city bike trips under 2 miles)	**140 $MTCO_2e$**

Per person savings potential

17.95 gallons gasoline 1-mile trips[283]	0.2 $MTCO_2e$[284]
330 annual vehicle-mile reduction	
35.85 gallons gasoline 2 mile-trips	0.3 $MTCO_2e$
660 annual vehicle mile reduction	

Implementation summary for Sub Action 5.1

This action assumes 610 persons will walk (or bike), rather than drive, for 1-mile in city travel trips.

- **Sub Action 5.1** can be accomplished as follows:

Implementation unit:	5 persons
Implementation units needed:	122

Implementation Schedule

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0.2	0.2	0.2	0.3	1.0
No. units	24	24	37	37	122
$MTCO_2e$	21	21	32	32	106

Upon full implementation, this action may offer the following savings per year.[285]

Gasoline	10,950 gallons	$32,800

This action may result in average annual savings per person of approximately $54.

Implementation Summary for Sub Action 5.2

This action assumes 400 persons will ride a bike, rather than drive, for 2-mile in city travel trips.

- **Sub Action 5.2** can be accomplished as follows:

Implementation unit:	5 persons
Implementation units needed:	80

Implementation Schedule

2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total

Percent	0.2	0.2	0.3	0.3	1.0
No. units	16	16	24	24	80
$MTCO_2e$	28	28	42	42	140

Upon full implementation, this action may offer the following savings per year.[286]

Gasoline	14,340 gallons	$43,000

This action may result in average annual savings per person of approximately $108.

Additional Considerations

Benefits of increased walking and bicycling include reduced dependence on automobiles, lower cost of transportation, reduced congestion, and reduced release of air pollutants.

A focused outreach and marketing campaign to promote a shift from automobile travel to walking and biking can be implemented immediately. The Mayor's Conservation Corps can help promote this endeavor. The Bridgeport Regional Business Council's first annual Workplace Walking Challenge supported this action, and can be expanded. Local hospitals have a role to play in helping residents appreciate the health benefits associated with a shift from automobile to walking and biking for short trips.

Schools can play a vital role in encouraging students to reach neighborhood schools in walking or bicycling groups in place of automobile.

Flat roadways in the City's southern section make bike riding easy. The City is currently developing several pilot "Complete Streets" routes to facilitate a shift to biking and walking. Resident support of this action will likely grow once these pilot projects are visible and usable.

A section of former railroad bed is already converted to a walking trail, but requires improved signage to bring users to it. This can be an early action item.

In many cases, improving bike and pedestrian infrastructure will require substantial financial commitment on the part the City, but this can be worked into ongoing maintenance funding.

Mircrobusiness development for bike sharing is a logical opportunity associated with this action item.

Employment opportunity associated with this action was not quantified by this energy plan.

ACTION 6 REDUCE MUNICIPAL FLEET EMISSIONS

- ***Sub Action 6.1 - Reduce municipal motor vehicle and landscape equipment emissions by 10% from 2007 baseline***

  Goal: Enact a municipal fleet strategy, which relies on minimum efficiency standards, natural trade-in to more-efficient vehicles and reduced VMT.

Annual Savings Potential by 2030 **532 $MTCO_2e$**

The 2007 municipal transportation-related energy and emissions were as follows:[287]

547,434 gallons gasoline 5,318 $MTCO_2e$[288]

8,546,720 vehicle mile equivalent

10% savings would equal 532 $MTCO_2e$.

Gasoline/diesel savings potential is 54,734 gallons of gasoline

Implementation Summary

This action assumes 10% reduction in emissions reduction will be achieved through reduced travel, natural trade-in to more efficient vehicles and minimum efficiency standards.

This action can be accomplished as follows:

Implementation unit: 1% reduction

Implementation units needed: 10

Implementation Schedule

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0.2	0.2	0.3	0.3	1.0
No. Units	2	2	3	3	10
$MTCO_2e$	106	106	160	160	532

Upon full implementation, this action may offer the following savings per year.[289]

Gasoline 54,743 gallons $164,200

Additional Considerations

Bridgeport is pursuing a municipal program to reduce VMT associated with the city fleet. GPS devices have effectively increased driver awareness of VMT and prompted reductions. Take home vehicle usage is being curbed by new city policy.

The City uses substantial landscape equipment to care for open space, parks, roadways and recreational areas. Two-cycle engines create oil-related emissions, which were noted, but not quantified in the Bridgeport

2007 GHG inventory. The City can take advantage of green fuel opportunities that exist with regards to landscape oils and fuel in order to reduce gasoline emissions.

Within 10 years, implementing minimum efficiency standards for fleets performing City-contracted work may prove to be a logical extension of Bridgeport municipal action to reduce transportation-related emissions. Other municipalities are already setting standards of this kind.

Employment opportunity associated with this action was not quantified by this energy plan.

ACTION 7 SWITCH TO CLEANER FUELS

- ***Sub Action 7.1 - Shift to vehicles fueled by CNG***
  Goal: Reduce emissions by 2,312 $MTCO_2e$ through switch to CNG-fueled vehicles.

Annual Savings Potential by 2030 **2,312 $MTCO_2e$**

Per vehicle savings potential[290]

95 gallons gasoline equivalent — 2.3 $MTCO_2e$
12,000 vehicle mile reduction

Implementation Summary

This action assumes a shift from 1,000 gasoline-powered passenger vehicles to 1,000 vehicles fueled by CNG.

This action can be accomplished as follows:

Implementation unit: 20 CNG vehicles
Implementation units needed: 50

Implementation Schedule

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0	0.1	0.4	0.5	1.0
No. units	0	5	20	25	50
$MTCO_2e$	0	231	925	1,156	2,312

Upon full implementation, this action may offer the following savings per year.[291]

Gasoline 95,000 gallons $285,000
Total VMT reduction 12,000,000

CNG is currently costs slightly less than gasoline on a per gallon fuel equivalent basis.[292] CNG vehicles still use internal combustion engines, and are not zero emission vehicles, but natural gas is considered clean burning, so it provides emissions benefit.[293]

Additional Considerations

The Connecticut Energy Advisory Board reports CNG vehicle sales are currently limited due to market challenges. Their assessment determines "CNG vehicles may achieve significant market penetration through some combination of the following events: low natural gas prices, sustained high oil prices, high battery costs, high electric costs, and low gas pressure vessel costs (i.e. lower costs of high-strength, light-weight composites)".[294]

One CNG fueling station currently exists in Bridgeport, and Enviro Express, located in Bridgeport, expects to open a CNG facility, which will be available to the public, at its facilities in the city in Fall 2010. This new station, funded in part by DOE under AARA, as part of the Greater New Haven Clean Cities project, will have a means for fueling Enviro Express' heavy trucks with LNG and also a recapture system, which enables LNG to be compressed to CNG. This new station may be one of the first, if not the first, public CNG stations open east of the Mississippi River.[295]

Indirect employment opportunity may be associated with this action, but was not quantified by this energy plan.

- ***Sub Action 7.2 - Shift to PEV***
  Goal: Reduce emissions by 21,000 $MTCO_2e$ through switch to PEV vehicles.

Annual Savings Potential by 2030 **21,000 $MTCO_2e$**

Per vehicle savings potential[296]

506 gallons gasoline equivalent 4.2 $MTCO_2e$
12,000 vehicle mile reduction

Implementation Summary

This action assumes a shift from 5,000 traditional fueled vehicles to 5,000 Plug in electric vehicles.

This action can be accomplished as follows:

Implementation unit:	20 plug in electric vehicles (PEV's)
Implementation units needed:	250

Implementation Schedule

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0	0.1	0.4	0.5	1.0
No. units	0	50	100	125	250
$MTCO_2e$	0	2,100	8,400	10,500	21,000

Upon full implementation, this action may offer the following savings per year.[297]

Gasoline equivalent[298]	2,530,000 gallons	$7,590,000
Total VMT reduction	60,000,000	

Electricity consumption increases associated with this measure are not quantified by this energy plan.

Additional Considerations

The Connecticut Electric Distribution Companies report that PEV's will likely achieve uncertain fleet penetration over the next decade, and consider a five percent level by 2020 optimistic. Under optimistic penetration, CO_2 and NO_X emissions are anticipated to decrease and SO_2 emissions will decrease very slightly.[299]

The Connecticut Electric Vehicles Infrastructure Council (CEVIC) is currently targeting Connecticut for PEV development. Barriers to PEV development exist. The average cost of a PEV is $35,000-$40,000. When charged at regular electric retail rates, operating costs of PEV's likely do not readily offset upfront prices,[300] a barrier to implementation for most Bridgeport residents. CEAB predicts EVs or PHEVs are only going to achieve significant market penetration through some combination of low electric rates for charging, high gasoline prices, lower battery costs, and government subsidies.[301]

The CEAB will monitor the Regional Electric Vehicle Initiative ("REVI") and CEVIC activities for potential impacts of PEV's on electricity demand, grid and transmission.[302]

For the next 5 years, PEV's are not anticipated to play a role in emissions reductions in Bridgeport. Following 2015, small impact may occur as a result of Bridgeport community purchasing decisions, but more impact will likely result from decisions of a broader population and cars travelling through Bridgeport, not garaged in Bridgeport.

Indirect employment opportunity may be associated with this action, but is not quantified by this energy plan.

ACTION 8 ACHIEVE HIGHER FUEL EFFICIENCY COMMUNITY-WIDE

- ***Sub Action 8.1 - Emissions gain from higher CAFÉ standards***
  Goal: Reduce emissions associated with 550,000,000 VMT through gradual phase-in of vehicles having improved efficiency standards as a result of new federal mandate.

Annual Savings Potential by 2030 **65,515 $MTCO_2e$**

Per vehicle savings potential[303]

Gasoline	191 gallons	1.8 $MTCO_2e$
12,000 vehicle mile reduction		

Implementation Summary

This action assumes a shift from 18.4 mpg average to 24 mpg average efficiency in cars travelling in (or thru) Bridgeport and resulting in 550,000,000 VMT within city limits, or approximately 77% of 2030 expected VMT.

This action can be accomplished as follows:

Implementation unit:	100 five-mile vehicle trips[304]
Implementation units needed:	1,100,000

Implementation Schedule

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0	0.1	0.2	0.7	1.0
No. units	0	110,000	220,000	770,000	1,100,000
$MTCO_2e$	0	6,551	13,103	45,860	65,515

Upon full implementation, this action may offer the following savings per year.[305]

Gasoline	6,974,638 gallons	$20,923,900
Vehicle mile reduction	550,000,000	

This action may result in average annual savings per vehicle of approximately $189 for every 5,000 vehicle miles travelled.[306]

Additional Considerations

The emissions gain from this action is expected to result, in large part, to a change in fuel efficiency in the vehicles travelling "thru" Bridgeport on I-95 and Route 8/25 as opposed to in-city travel.

There is no direct employment opportunity associated with implementation of this action item.

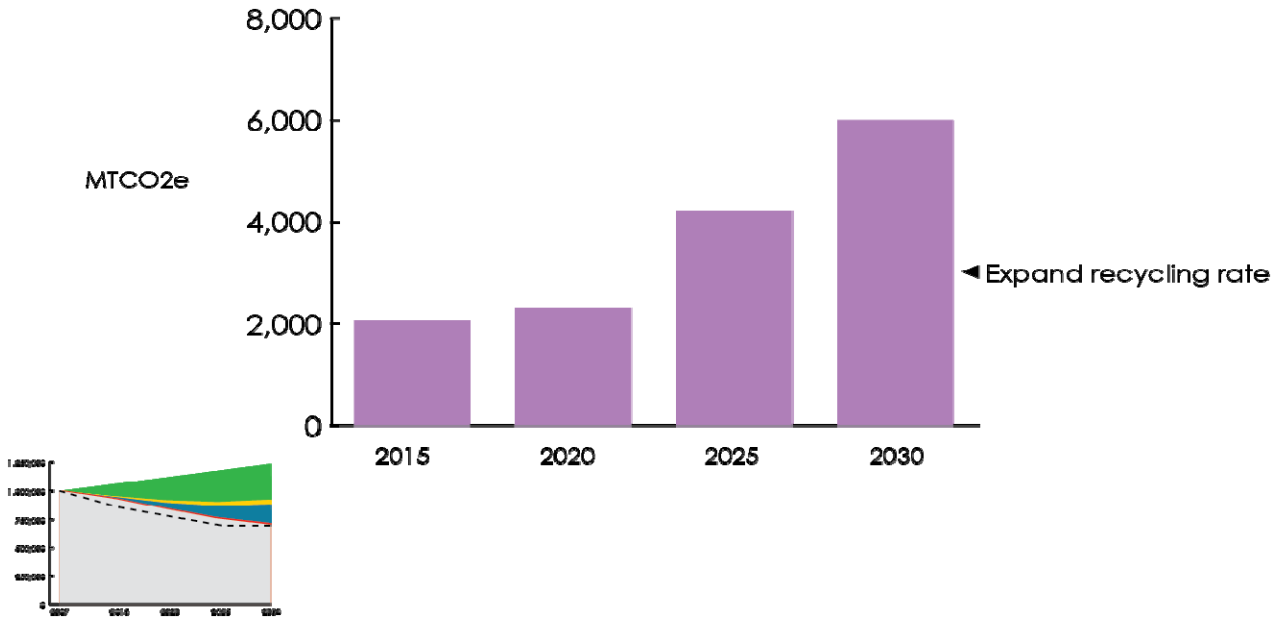
WASTE AND RECYCLING

SUMMARY

1.6% of total reduction 2010 to 2015

1.1% of cumulative reduction by 2030

Waste and Recycling		**$MTCO_2e$**
Action 1	Expand recycling rate to 16% by 2015 and 35% by 2030	6,128
Action 2	Aggressive recycling promotion to achieve 80% household participation by 2015	--
Action 3	Aggressive recycling promotion to achieve 80% commercial sector recycling participation by 2015	--
Action 4	Develop community composting program	--
Action 5	Actively pursue emissions avoidance through reuse, reduction, or green procurement	--
Action 6	Single Stream or more aggressive collection process	--
	Annual Emissions Reduction by Full Implementation 2030	**6,128**



SAVINGS (annual by full implementation)	
Tipping fees	**$1.73 million**
GAINS	
Fulltime equivalent work-years	**Not quantified**
Notable micro-business opportunities	**Not quantified**

Narrative Summary

- Bridgeport's incineration of municipal solid waste (MSW) is technically a biomass-fueled operation, in part, and provides electricity-generation, so increased recycling (meaning diversion from incineration) does not show the same carbon reduction impacts as diversion from landfilling.
- If life-cycle is taken into account, impacts are greater (although they are not quantified by this energy plan). Expanding reuse and recycle is a benefit to keeping many materials "in circulation."
- Increasing recycling *participation* is paramount to diverting tonnage from incineration to recycle and reuse. This plan proposes a fast-tracked and aggressive strategy for creating 80% recycling participation by residents and businesses, quantified and monitored separately from tonnage diverted.
- Residential participation will be bolstered by The Mayor's Conservation Corps and Environmental Justice community group outreach as well as by the City's launch of a pilot recycling incentive program expected to commence within the year.
- The City, BRBC and DSSD will be pivotal to establishing more widespread commercial recycling. A recycling and MSW Management Forum, sponsored by the City of Bridgeport, recently jumpstarted focused attention on an expanded citywide recycling goal and a variety of micro-business opportunities related to solid waste management.
- Composting on several scales will divert significant materials from incineration, although non-commercial composting may result in increased methane release. Larger scale commercial facilities can manage waste and emissions, resulting in a net decrease.
- "Single Stream" or more aggressive system has prompted greater diversion from incineration in many towns, and will likely become a part of Bridgeport's future MSW/Recycling operations.
- Expanded recycling in schools, expected in pilot stage in Fall 2010, will establish a stronger recycling mindset with carry-over benefit to residential participation.
- Employment opportunities linked to MSW and recycling are not identified in this plan, but it is certain that many will evolve. Materials waste management is extremely varied and there is tremendous potential to develop a host of associated micro-businesses. Much of Bridgeport's commercial building space is well suited to associated start-ups.

ACTION 1	EXPAND RECYCLING RATE TO 16% BY 2015 AND 35% BY 2030

- ***Sub Action 1.a - Increase recycling rate to 16% by 2015 Low Growth; and increase recycling to 16% by 2015 High Growth***

  Goal: Increase the 2007 recycling rate by 400% by 2015 to reach 16% recycling target.

Annual Savings Potential by 2030 Low Growth (16% target)	**2,564 $MTCO_2e$**
Additional Annual Savings High Growth (16% target)	**181 $MTCO_2e$**

A. Current and projected emissions with no change in recycling rate

2007 MSW and recycling were as follows:[307]

MSW incinerated	63,081 tons
MSW recycled	2,548 tons
Total MSW	65,629 tons
Recycling rate	4.039 %
Emissions from incineration[308]	*12,698 $MTCO_2e$*

Projected 2030 MSW and recycling Low Growth[309] **with continued 4.039% recycle rate**

MSW incinerated	75,786 tons
MSW recycled	3,061 tons
Total MSW	78,847 tons
Projected emissions	*15,872 $MTCO_2e$*

Projected 2030 MSW and recycling High Growth with continued 4.039% recycle rate

MSW incinerated	81,141 tons
MSW recycled	3,278
Total MSW	84,419 tons
Projected emissions	*16,993 $MTCO_2e$*

Analysis:

In 2007, incineration of municipal solid waste created 12,698 $MTCO_2e$*.*
With no change in recycling rate, by 2030 under the High Growth scenario, municipal solid waste will create 16,993 $MTCO_2e$ *as a result of increased population and the trend toward increased municipal solid waste per capita.*

B. Implementation of Increased Recycling

Increasing recycling to 16% (400% increase) assuming 2030 Low Growth[310]

MSW incinerated	66,108 tons
MSW recycled	12,739 tons
Total MSW	78,847 tons

Projected emissions from incineration *13,307 $MTCO_2e$*

Emissions reduction over continued 4.039% recycle **2,564 $MTCO_2e$**

Increasing recycling to 16% (400% increase) – impact of High Growth

MSW incinerated 70,0779 tons

MSW recycled 13,640 tons

Total MSW 84,419 tons

Projected emissions from incineration *14,248 $MTCO_2e$*

Emissions reduction over continued 4.039% recycle, Low Growth growth **181 $MTCO_2e$**

Implementation Summary

This action can be accomplished as follows:

Implementation unit: 10% goal achievement

Implementation units needed: 10

Implementation Schedule Low Growth Scenario

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0.8	0.1	0.05	0.05	1.0
No. units	8	1	0.05	0.05	10
$MTCO_2e$	2,052	256	128	128	2,564

Implementation Schedule High Growth Scenario

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0	0	0.5	0.5	1.0
No. units	0	0	5	5	10
$MTCO_2e$	0	0	91	91	181

Annual Energy and Utility Cost Savings upon Full Implementation in 2030

Upon full implementation, this action may impact electricity generation and energy consumption. Diverting municipal solid waste from incineration will alter the mix of biogenic/non-biogenic material used to generate electricity at the Bridgeport waste to energy plant. A shift to transporting recycled materials to recycling facilities under the existing system has little impact on transportation-related diesel truck emissions associated with hauling by Bridgeport municipal trucks, but longer distance transport of recyclables could be impacted. Reduced ash transport from incineration would be expected. These impacts are not quantified in this energy plan. Bridgeport may have opportunities to create recycling facilities for a number of resource materials within the city. (See Municipal Solid Waste and Recycling Action 6.)

Additional Considerations

Under the Low Growth scenario, increasing recycling from the current rate to 16% removes 9,678 tons of MSW from incineration, which creates annual ***savings*** *to the City of Bridgeport* ***of $609,700 in tipping fees****.*[311]

Under the High Growth scenario, when 16% recycling is achieved, an additional 901 tons of MSW is recycled, which ***saves*** *the City an* ***additional $56,763 in tipping fees****.*

Critical to reaching emissions reduction goals associated with recycling will be increased participation in recycling programs. Waste and Recycling Actions 2 and 3 of this Bridgeport Energy Plan outline a plan for achieving 80% recycling participation by residents and businesses.

- ***Sub Action 1b - Increase Bridgeport's residential recycling rate to 35% by 2030 Low Growth Scenario; and increase Bridgeport's residential recycling rate to 35% 2030 High Growth (additional savings)***
  Goal: Move forward from the interim 15% recycling rate to longer-term 35% diversion from disposal.

Annual Savings Potential by 2030 (35% target)	**2,991 $MTCO_2e$**
Additional Savings High Growth (35% target)	**393 $MTCO_2e$**

Increasing recycling from 16% to 35% assuming 2030 Low Growth

MSW incinerated	51,251tons	
MSW recycled	27,596 tons	
Total MSW	78,847 tons	
Emissions		*10,317 $MTCO_2e$*
Decrease over current recycle rate		*5,555 $MTCO_2e$*
Emissions reduction over 16% recycle, Low Growth		**2,991 MCTO2e**

Increasing recycling from 16% to 35%– impact of High Growth

MSW incinerated	54, 872 tons	
MSW recycled	29,547 tons	
Total MSW	84,419 tons	
Emissions		*11,045 $MTCO_2e$*
Decrease over current recycle rate		*5,948 $MTCO_2e$*
Emissions reduction over 16% recycle, Low Growth		**392 $MTCO_2e$**

This action can be accomplished as follows:

Implementation unit:	10% goal achievement
Implementation units needed:	10

Implementation Schedule for Low Growth

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0	0	0.5	0.5	1.0
No. units	0	0	5	5	10
$MTCO_2e$	0	0	1,495	1,495	2,991

Implementation Schedule for High Growth

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0	0	0.5	0.5	1.0
No. units	0	0	5	5	10

$MTCO_2e$	0	0	196	196	392

Analysis:
Increasing recycling to 35% of total MSW results in projected emissions of 11,045 $MTCO_2e$, which is a total decrease of 5,948 over continued recycling at the current rate of roughly 4 percent. Upon full implementation, this action may impact electricity generation and energy consumption. Diverting municipal solid waste from incineration will alter the mix of biogenic/non-biogenic material used to generate electricity at the Bridgeport waste to energy plant. Transport of recycled materials to recycling facilities may increase diesel-related emissions. These impacts are not quantified in this energy plan. Bridgeport may have opportunities to create recycling facilities for a number of resource materials within the city. (See Municipal Solid Waste and Recycling Action 6.)

Additional Considerations
Under the Low Growth scenario, increasing recycling from 16% to 35% removes an additional 14,857 tons from incineration, which creates additional annual ***savings*** *over the 15% savings to the City of Bridgeport of* ***$936,000*** *per year in tipping fees.*[312]
Under the High Growth scenario, when 35% recycling is achieved, an additional 1,951 tons of MSW is recycled, which ***saves*** *the City an* ***additional annual savings over the 16% recycling level of $122,900 in tipping fees****.*

Critical to reaching these goals will be increased participation in recycling programs. Waste and Recycling Actions 2 and 3 outline strategies for achieving 80% recycling participation by residents and businesses.

ACTION 2 ACHIEVE 80% HOUSEHOLD PARTICIPATION IN RECYCLING BY 2015

Goal: Formalize a recycling outreach program to capture recycling participation by 38,035 households and enable success of increased recycling goals.

Implementation Summary
Achieving 80% recycling participation can be targeted, and tracked, as follows:

Implementation Schedule*

Establish 80% household recycling participation rate (among currently existing households) = 38,035 households by 2015	38,035 households
Household participation needed per year to achieve 80% confirmed participation among existing households within 5 years - by 2015 (some already confirmed)	7607
Households needed per week	146
Blocks of 20 households per week	7
Additional household participation needed to achieve 80% participation rate among 2030 new households under Low Growth	6098 households

(7,623 additional households by 2030)	
Additional households needed per year (20 year average)	305
Households needed per week average	6
Additional household participation needed to achieve 80% participation rate among new households under High Growth (8,000 additional households by 2030)	6,400 households
Additional household needed per year (20 year average)	320
Households needed per week average	6

*Rounding of numbers impacts totals

Additional Considerations

80% household participation in city recycling is challenging, but the materials currently accepted for recycling in Bridgeport are limited, making it less burdensome. Recycling is mandated by the State. This action item must be viewed as achievable.

A substantially visible citywide recycling campaign can become a continued focus of the Mayor's Conservation Corps door-to-door efforts. MCC outreach proved extremely effective in boosting recycling participation in targeted neighborhoods during a pilot program in 2009. MCC efforts will easily be supplemented by neighborhood- and school-based initiatives. The role of city Recycling personnel will be to identify and remove logistical barriers, which deter certain households from recycling.

One known deterrent to recycling participation is biweekly pick-up of recyclables. This poses both a burden for storage and creates confusion related to knowledge of proper pick-up dates. With relatively little effort, neighborhood recycling leaders and the small business community can assume leadership roles in notifying residents of proper recycling pick-up dates, if a viable campaign is put in place. Education is the only missing element.

Within the year, a pilot recycling incentive program will target the lowest rate neighborhoods. This also is expected to bolster recycling and save the City of Bridgeport money.

ACTION 3 INCREASE RECYCLING IN THE COMMERCIAL SECTOR TO ACHIEVE 80% PARTICIPATION BY 2015

Goal: Formalize a commercial recycling education and outreach program to increase recycling participation and enable success of increased recycling goals.

Implementation Summary

Achieving 80% business recycling participation can be targeted, and tracked, as follows:

Implementation Schedule*

Establish 80% commercial recycling participation (among currently existing C/I buildings)	1957 C/I buildings
Buildings needed per year to achieve 80% confirmed participation within 5 years - by 2015 (some already confirmed)	391
Buildings needed per week	8
Additional C/I building participation needed to achieve 80% participation rate among new C/I buildings under Low Growth (231 additional buildings constructed by 2030)	185 buildings
Additional buildings needed per year (20 year average)	9
Additional C/I building participation needed to achieve 80% participation rate among new C/I buildings under High Growth (195 additional buildings constructed by 2030)	156 buildings
Buildings needed per year (20 year average)	8

*Rounding of numbers impacts totals

Additional Considerations

A recent City-sponsored community-wide commercial recycling forum jumpstarted efforts to establish full-fledged commercial recycling in Bridgeport. While a number of Bridgeport companies currently run robust recycling programs, other do not. This forum both provided resources to enable non-participants to recycle, and identified economic development opportunities related to solid waste diversion, recycle and reuse. A valuable piece of this forum was inclusion of waste haulers in the discussions, since they form a critical link to recycling programs. The City will likely provide continued leadership in promoting recycling's value. Bridgeport Regional Business Council, through its Green Business Resource Center, must assume educational outreach responsibility to the business community.

The City of Bridgeport is exploring feasibility of expanding its residential recyclables pick-up to include Downtown Special Services District, as a demonstration pilot.

Bridgeport's Energy Improvement District can join with the City of Bridgeport and the Bridgeport Regional Business Council in developing a citywide commercial waste audit to identify wastes and determine any matches between one business's wastes and another business's materials need. This effort can subsequently be expanded region wide.

Bridgeport's Energy Improvement District can also join with the City of Bridgeport, Bridgeport Regional Business Council, the WorkPlace, and The Green Team, to develop a working list of viable micro-business opportunities associated with material recycling. Several initial opportunities became evident during the recent commercial recycling forum.

ACTION 4 DEVELOP COMMUNITY COMPOSTING PROGRAM

Goal: Explore opportunities for a managed commercial composting facility with release of oxidized methane (biogenic CO2) only.

Annual Savings Potential by 2030 **$MTCO_2e$ not quantified**

Emissions increase/decrease is technology-dependent.

An EPA grant is funding a feasibility study for a regional commercial composting center. Hospitals, supermarkets, the BOE centralized food service prep site, and Bridgeport's three universities offer readily-accessible sources of food waste. Additional compost sources can be added to operations.

Composting facility operations will easily link to a soil enhancement program for community gardens and other sites. This tie-in will provide opportunity for employment and development of a supportive (possibly nonprofit ReEntry community) micro-business.

A program for household and neighborhood composting is also achievable, but unlike a regulated commercial facility, site-specific composting on this scale may negatively impact emissions, due to methane release.

Employment opportunity is expected from establishing a commercial composting operation, but this Energy Plan does not quantify this opportunity.

Implementation Schedule

2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Feasibility study				
	Development and operation			

ACTION 5 ACTIVELY PURSUE EMISSIONS AVOIDANCE THROUGH REUSE, REDUCTION, OR GREEN PROCUREMENT

- ***Sub Action 5.1 - Model commercial procurement policies and programs after recently adopted Municipal Procurement Policy***
- ***Sub Action 5.2 - Expand municipal reuse, reduction or green procurement strategy***
  Goal: Jointly enable expansion of existing municipal and commercial reuse, reduction or green procurement strategies through directed discussion and collaborative efforts.

Annual Savings Potential by 2030 **$MTCO_2e$ not quantified**

Implementation Summary

In 2009, the City of Bridgeport adopted a formal Green Procurement Policy, based upon EPA green procurement guidelines and with the efforts of a BGreen green procurement-working group. The City's leadership in establishing this policy can benefit the Bridgeport business community, by means of the Green Resources Center at the Bridgeport Regional Business Council. In turn, BRBC business members may provide additional examples of green procurement opportunities to benefit both member businesses and the City. A forum on green procurement would benefit all.

Opportunities for group purchase of green products and services should be pursued as another possible benefit of increased public/private procurement discussions.

The City's current tire recapping, and cleaning products and paper purchase programs, should be viewed as the start of increased green procurement. One immediate area of opportunity is the purchase of "green" oils for single engine landscape equipment.

Employment opportunities related to this action item, if any, are not quantified by this energy plan.

ACTION 6 SINGLE STREAM OR MORE AGGRESSIVE COLLECTION PROCESS

Goal: Expand materials reuse through single stream recycling or more aggressive municipal solid waste treatment program.

Annual Savings Potential by 2030 **$MTCO_2e$ not quantified**

Implementation Summary and Considerations

Single stream recycling is enabling an increasing number of municipalities to notably ramp up recycling and diversion from incineration or landfill.[313] Recycling facilities used by Bridgeport may shift to single stream, enabling greater recycling potential.

Bridgeport can also take regional leadership in establishing micro-businesses associated with specialized materials reuse. The majority of waste is re-usable or – compostable. The work is labor-intensive, which is an advantage to Bridgeport.

The Energy Improvement District, Department of Economic Development, and City Recycling can jointly explore feasibility of launching recycling microbusinesses in enclosed facilities Bridgeport to serve regional need and redefine our region's waste management.

Construction and demolition materials generally reach final disposal in landfill sites. The City can take a lead in material reuse by creating strong C & D recycling policies and programs, which tie into business opportunities and economic development.

An increasing number of municipalities are evaluating zero waste policies. Life-cycle savings of a zero waste policy are substantial, and the majority of these savings come from reducing emissions associated with recycling compared to using new materials. Zero waste reduces methane associated with landfilling, and reduces transportation-related emissions created by hauling trash from the city to landfills located out of state. Zero waste policies will require changes to behavior, consumer packaging and infrastructure.[314]

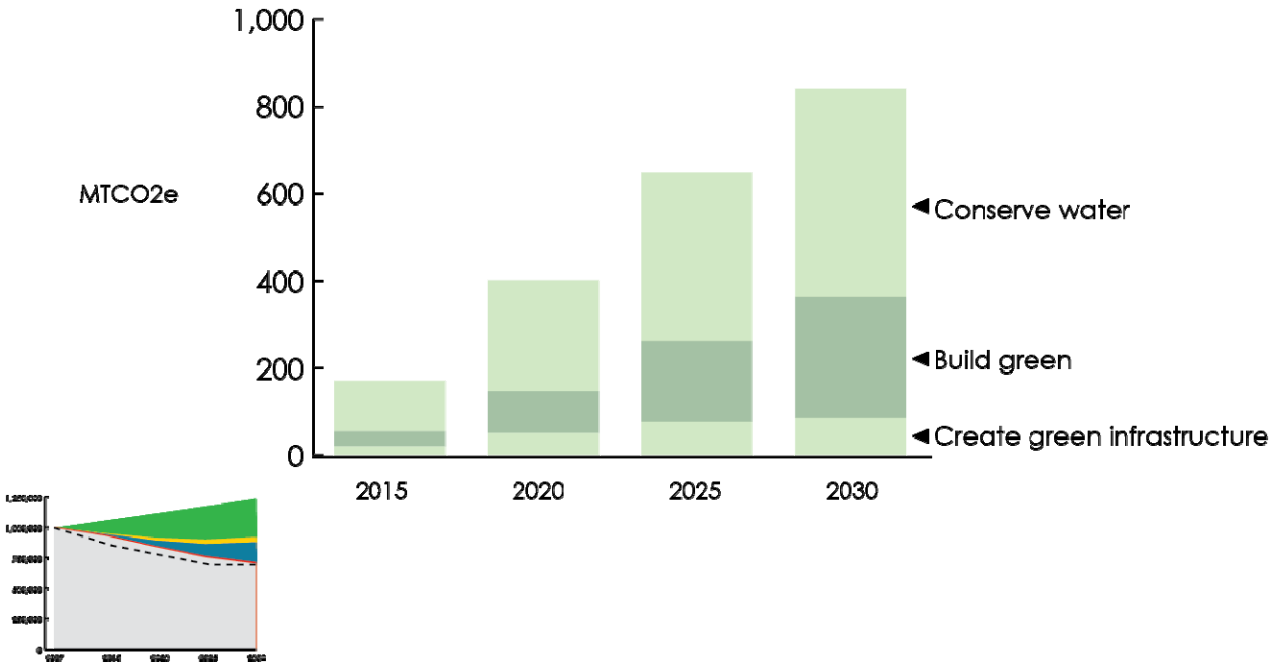
WATER RESOURCES

SUMMARY

0.13% of total reduction, 2010 to 2015

0.15% of cumulative reduction by 2030

Water Resources		**$MTCO_2e$**
Action 1	Water and energy conservation through efficiency (water-related impact only)	478
Action 2	Build Green to reduce water usage by 40%	277
Action 3	Green Infrastructure	85
	Annual Emissions Reduction by Full Implementation 2030	**841**



SAVINGS (annual by full implementation)	
Energy cost savings	**$9.74 million**
Water savings and/or treatment diversion	**1.1 billion gallons**
GAINS	
Fulltime equivalent work-years	**245+**

Narrative Summary

- If all items of the Plan are fully implemented, 1.1 billion gallons of water a year (an average exceeding 3 million gallons per day) may be detained or retained from the WPCA system. This will reduce energy demand for treatment and emissions, and provide a valuable buffer to the city stormwater management and flood control capacities.

- Conservation and efficiency, promoted by current water- company and other efficiency programs, can easily expand to provide small cost savings to customers, as well as water control benefit during dry and wet weather. Per customer demand is already on the decline, likely as a result of these programs.[315]

- Careful installation of green infrastructure, including green roofs, rain gardens, and bioswales, can also significantly assist localized water management and flood control. Green roofs will yield strong co-benefits related to building energy, solar PV efficiency and outdoor air quality and temperature.

- Increasingly, cities, including New York City and Philadelphia, report notable benefits to stormwater control, as a result of conservation, efficiency and outdoor green infrastructure. Green roof modeling for Washington D. C. shows significant promise to reduce CSO's, either by reducing total water input to the treatment system, or altering input timing. Bridgeport must draw from these, and other, models.

- Green roof installation and maintenance, as well as rain garden installation, offer job opportunities of close to one thousand work-years, an additional incentive to their implementation.

- New construction and renovations to Bridgeport buildings will certainly achieve water savings, due to improved inherent fixture and system efficiencies.

- The City can promote additional water savings through green building incentives.

- Water "audits" can identify effective ways to reduce water usage in commercial facilities; the EID can assist in creating financing mechanisms for audits and retrofit action.

- City streets and right-of-ways must be viewed as essential elements in water management, and must be employed to significantly temper stormwater flow and benefit water quality in rivers and Long Island Sound.

- The City, as a property owner, has an opportunity to work with WPCA and private landowners, to create water management zones to capture or divert stormwater and provide flood control. Private/public partnership is essential to this effort's success.

- As the WPCA works with the State of Connecticut in creating a Long Term Control Plan, green infrastructure inclusion will be essential. Baseline study is needed to quantify potential economic and water quality impact of wide scale implementation. As already noted, action items in this Plan identify means for conserving, retaining, or detaining over 1 Billion gallons of water a year, a small amount compared to the City's whole, but, 3 million gallons/day average being slowed or eliminated from storm sewer systems can prove critical to localized flood control.

ACTION 1 WATER AND ENERGY CONSERVATION THROUGH EFFICIENCY

- ***Sub Action 1.1 - Install 1 low flow showerhead in 50% of existing households***
- ***Sub Action 1.2 - Install one low flow showerhead in 80% of 7,623 new households[316] 2030 Low Growth***
- ***Sub Action 1.3 - Install one low flow showerhead in 80% of 8,000 additional new households 2030 High Growth***

  Goal: Reduce water use and emissions related to water supply, use, and treatment through installation of efficient equipment.

Annual Savings Potential by 2030	
Sub Action 1.1 Existing households	**116 $MTCO_2e$**
Sub Action 1.2 Low Growth	**30 $MTCO_2e$**
Sub Action 1.3 High Growth	**32 $MTCO_2e$**

Annual energy savings potential per showerhead[317]

Electricity	11.8 kWh[318]	0.005 $MTCO_2e$ [319]
Water	4,271 gallons[320]	

Implementation Summary

This action assumes installation of 1 low flow showerhead in 23,771 existing households, 6,098 new households under Low Growth scenario and 6,400 additional new households under the High Growth scenario.[321]

- **Sub Action 1.1 can be accomplished as follows:**

Implementation unit: 10 households

Implementation units needed: 2,377

Implementation Schedule for Sub Action 1.1 Existing households

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0.4	0.3	0.2	0.1	1.0
No. units	951	713	475	238	2,377
$MTCO_2e$	47	34	23	12	116

Upon full implementation, this action may offer the following savings per year.

Electricity	280,583 kWh	$18,300 to utility for water supply
		$24,000 to WPCA for water treatment
Water	101,525,941 gallons	$746,200 to customers for water supply
		$219,900 to customers for water treatment

This action may result in average annual utility savings related to water supply and treatment per household of approximately $40.

- **Sub Action 1.2 can be accomplished as follows:**

Implementation unit: 10 households
Implementation units needed: 610

Implementation Schedule for Sub Action 1.2 New Households Low Growth

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0.25	0.25	0.25	0.25	1.0
No. units	153	153	152	152	6010
$MTCO_2e$	7.47	7.47	7.47	7.47	29.88

Upon full implementation, this action may offer the following savings per year:

Electricity	71,974 kWh	$4,700 to utility for water supply
		$6,100 to WPCA for water treatment
Water	26,042,850 gallons	$191,400 to customers for water supply
		$56,400 to customers for water treatment

This action may result in average annual utility savings related to water supply and treatment per household of approximately $40.

- **Sub Action 1.3 can be accomplished as follows:**

Implementation unit: 10 households

Implementation units needed 640

Implementation Schedule for Sub Action 1.3 New Households High Growth

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0	0.2	0.4	0.4	1.0
No. units	0	128	256	256	640
$MTCO_2e$	0	6.27	12.54	12.54	31.36

Upon full implementation, this action may offer the following savings per year:

Electricity	75,543 kWh	$4,900 to utility for water supply
		$6,500 to WPCA for water treatment
Water	27,334,400 gallons	$200,900 to customers for water supply
		$59,200 to customers for water treatment

This action may result in average annual utility savings related to water supply and treatment per household of approximately $40.

Additional Considerations

This measure is included in the UI Home energy Solutions (HES) and Income Eligible programs.

Labor and job potential associated with this action is attributed to an action detailed in another section of this Energy Plan.

- ***Sub Action 1.4 - Install faucet aerators in 50% existing households***
- ***Sub Action 1.5 - Install faucet aerators in 80% of new households under Low Growth scenario***
- ***Sub Action 1.6 - Install faucet aerators in 80% of additional new households under High Growth scenario***

  Goal: Reduce water use and emissions related to water supply, use and treatment through installation of efficient equipment.

Annual Savings Potential by 2030	
Sub Action 1.4 Existing households	**14 $MTCO_2e$**
Sub Action 1.5 Low Growth	**3.6 $MTCO_2e$**
Sub Action 1.6 High Growth	**3.8 $MTCO_2e$**

Annual energy savings potential per installation of 2 aerators[322]

Electricity	1.4122 kWh[323]	0.0006 $MTCO_2e$[324]
Water	511 gallons[325]	

Implementation Summary

This action assumes installation of 2 faucet aerators in 23,771 existing households and 6,089 new households under Low Growth scenario and an additional 6,400 new households under High Growth scenario.

- **Sub Action 1.4 can be accomplished as follows:**

Implementation unit: 10 households
Implementation units needed: 2,377

Implementation Schedule for Sub Action 1.4 Existing households

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0.4	0.3	0.2	0.1	1.0
No. units	951	713	475	238	2,377
$MTCO_2e$	5.57	4.18	2.79	1.39	13.94

Upon full implementation, **Sub Action 1.4** may offer the following savings per year.

Electricity	14,577 kWh	$2,200 to utility for water supply $2,900 to WPCA for water treatment
Water	12,146,981 gallons	$89,300 to customers for water supply $26,300 to customers for water treatment

This action may result in average annual utility savings related to water supply and treatment per household of less than $5.

- **Sub Action 1.5 can be accomplished as follows:**

Implementation unit: 10 households
Implementation units needed: 610

Implementation Schedule for Sub Action 1.5 New Households Low Growth

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0.25	0.25	0.25	0.25	1.0
No. units	153	153	152[326]	152	610
$MTCO_2e$	0.89	0.89	0.89	0.89	3.58

Upon full implementation, **Sub Action 1.5** may offer the following savings per year:

Electricity	8,612kWh	$550 to utility for water supply $700 to WPCA for water treatment
Water	3,116,078 gallons	$22,900 to customers for water supply $6,750 to customers for water treatment

This action may result in average annual utility savings related to water supply and treatment per household of less than $5.

- **Sub Action 1.6 can be accomplished as follows:**

Implementation unit: 10 households
Implementation units needed 640

Implementation Schedule for Sub Action 1.6 New Households High Growth

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0	0.2	0.4	0.4	1.0
No. units	0	128	256	256	640
$MTCO_2e$	0	0.75	1.50	1.50	3.75

Upon full implementation, **Sub Action 1.6** may offer the following savings per year:

Electricity	9,038 kWh	$600 to utility for water supply $750 to WPCA for water treatment
Water	3,270,400 gallons	$24,000 to customers for water supply $7,000 to customers for water treatment

This action may result in average annual utility savings related to water supply and treatment per household of less than $5.

Additional Considerations

This measure is included in the UI Home energy Solutions (HES) and Income Eligible programs.

Aquarion water conservation education and outreach programs provide aerators in some cases.

Faucet aerators can cost less than $1 and reap savings far greater than the initial cost.

Labor and job potential associated with this action is attributed to an action detailed in another section of this Energy Plan.

- ***Sub Action 1.7 - Install low flow toilets in 50% of existing households***

  Goal: Reduce water use and energy required for wastewater treatment through installation or more efficient fixtures.

Annual energy savings potential by 2030 **279 $MTCO_2e$**

Annual savings potential per toilet fixture[327]

28.29 kWh electricity[328] 0.01 $MTCO_2e$[329]
10,237 gallons water[330]

Implementation Summary

This action assumes installation of low flow toilets, which represent replacement of 3.5-gallon fixtures with 1.6-gallon low flow fixtures, in 23,771[331] existing households.

This action can be accomplished as follows:

Implementation unit:	10 households
Implementation units needed:	2,377

Implementation Schedule

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0.2	0.3	0.3	0.2	1.0
No. units	475	713	713	475	2,377
$MTCO_2e$	56	84	84	56	279[332]

Upon full implementation, this action may offer the following savings per year.

Electricity	672,540 kWh	$43,800 to utility for water supply $57,400 to WPCA for water treatment
Water	243,350,060 gallons	$1,788,600 to customers for water supply $527,000 to customers for water treatment

This action may result in average annual utility savings related to water supply and treatment per household of $100.

Additional Considerations

Toilet rebate programs have proven successful in numerous municipalities, including New York City. Programs are either city-, state- or utility-sponsored.

Installation of low flow toilets, associated with this action, is estimated to create job potential for 47.5 fulltime equivalent work years.

- ***Sub Action 1.8 - Clothes washer trade-ins***

  Goal: Reduce water use and energy required for wastewater treatment through installation of more efficient clothes washers in 30% of 47,543 existing households.

Annual Savings Potential by 2030 **0.05 $MTCO_2e$**

Annual savings potential per clothes washer

Electricity	0.01547 kWh[333]	0.000004 $MTCO_2e$[334]

Water	6 gallons[335]

Implementation Summary

This action assumes replacement of existing clothes washers with more water-efficient clothes washers in 14,263 existing households.

This action can be accomplished as follows:

Implementation unit:	10 clothes washers
Implementation units needed:	1,426

Implementation Schedule

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0.25	0.3	0.2	0.1	1.0
No. units	357	357	357	357	1,426
$MTCO_2e$	0.01	0.01	0.01	0.01	0.05[336]

Upon full implementation, this action may offer the following savings per year.

Electricity	221 kWh	\$14 to utility for water supply \$18 to WPCA for water treatment
Water	79,844 gallons	\$585 to customers for water supply \$170 to customers for water treatment

This action may result in very minimal annual utility savings (less than \$1) related to water supply and treatment per household.

Additional Considerations

United Illuminating has an in-place program for Income Eligible participants, which enables clothes washer trade-in for more efficient appliances.

Numerous cities, states and/or water supply authorities offer clothes washer rebate programs.

Labor and job potential associated with this action is attributed to an action detailed in another section of this Energy Plan.

- ***Sub Action 1.9 - Conservation policies and education***
  Goal: Create a water-conservation consciousness, which runs the spectrum of water-conservation behavior, from utility scale decisions to household actions.

Annual Savings Potential by 2030 **$MTCO_2e$ not quantified**

Savings Potential and Implementation Summary
This action is intended to create "new thinking" with regards to water use and conservation, by instilling behavior, which addresses the need to use water wisely. Several actions support this goal:

Expand Aquarion water utility outreach programs to promote water-saving measures in all households and business operations, and save consumers money. The Bridgeport Regional Business Center's Green Resources Center, community centers and Lighthouse after-school program sites are logical partners for this action.

Enact Green Building Guidelines and incentives for new construction and renovations, which include water-saving fixtures and measures.

Promote water audits of large customer and retrofit programs that help consumers reduce water consumption and save money.

Promote water audits of Bridgeport municipal facilities and Board of Education facilities, which help the City install measures to reduce water consumption and save money.

Additional Considerations
Initiate discussions related to rain water capture and re-use for outdoor water needs.

Aquarion's residential water audit kit is a valuable handout, which must reach additional homes to enable savings. Kits include aerators and simple tools, which help residents check for water leaks.[337] The city, using the Mayor's Conservation Corps and business community can partner with Aquarion in this outreach effort.

For the commercial community, water audits will also help save more, but audit costs of $15,000 to $20,000 are a deterrent to implementation. Water utilities lack a surcharge mechanism to enable financial support of this measure. Bridgeport's Energy Improvement District and Bridgeport Regional Business Council can work to develop possible financing mechanisms and tie-ins to full-building retrofits and possible performance contracting.

ACTION 2 BUILD GREEN TO REDUCE WATER USAGE

- ***Sub Action 2.1 - Green building construction in 6,098 new households under Low Growth scenario***
- ***Sub Action 2.2 - Green building construction in 6,400 new households under High Growth scenario***
  Goal: Reduce water usage by 40% over traditional usage by performing green building measures in new construction.[338]

Annual Savings Potential by 2030, Low Growth	**135 $MTCO_2e$**
Additional Annual Savings Potential, Expanded growth	**142 $MTCO_2e$**

Annual Savings potential per household from green building
(Relates to energy for water supply and treatment only)

Electricity	53.38 kWh[339]	0.02 $MTCO_2e$[340]
Water	44,480 gallons [341]	

Implementation Summary

This action assumes performance of water-saving green building measures in 80% of 7,623 new households (6,098 households) by 2030 under the Low Growth scenario and 80% of 8,000 additional new households (6,400 households) under the High Growth scenario.[342]

- **Sub Action 2.1 Low Growth can be accomplished as follows:**

Implementation unit:	10 households
Implementation units needed:	610

Implementation Schedule for Sub Action 2.1 Low Growth

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0.25	0.25	0.25	0.25	1.0
No. units	152	152	152	152	610[343]
$MTCO_2e$	33.78	33.78	33.78	33.78	135.12

Upon full implementation, **Sub Action 2.1** Low Growth may offer the following savings per year.

Electricity	325,508 kWh	$48,800 to utility for water supply $64,000 to WPCA for water treatment
Water	271,246,713 gallons	$1,993,700 to customers for water supply $587,500 to customers for water treatment

This action may result in annual utility savings related to water supply and treatment per household of $425.

- **Sub Action 2.2 High Growth can be accomplished as follows:**

Implementation unit:	10 households
Implementation units needed:	640

Implementation Schedule for Sub Action 2.2 High Growth

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0	0.2	0.4	0.4	1.0
No. units	0	128	256	256	640
$MTCO_2e$	0	28.36	56.73	56.73	141.81

Upon full implementation, **Sub Action 2.2** High Growth may offer the following savings per year.

Electricity	341606 kWh	$51,200 to utility for water supply $67,200 to WPCA for water treatment
Water	284,672,000 gallons	$2,092,300 to customers for water supply $616,600 to customers for water treatment

This action may result in annual utility savings related to water supply and treatment per household of $425.

Additional Considerations

Incorporating green building measures into construction has added 2% on average to costs, but returns far more in savings over time, and some buildings are being built to LEED certified levels at little or no extra cost.[344] Overall, green building has been reported to have 20-year net benefits ranging from $50 to $65 per square foot.[345]

Labor and job potential associated with this action is attributed to an action detailed in another section of this Energy Plan.

ACTION 3 GREEN INFRASTRUCTURE

- ***Sub Action 3.1 - Install rain gardens at residences with flat roofs***
- ***Sub Action 3.2 - Install rain gardens at residences with pitched roofs***

  Goal: Protect water resources and reduce energy and emissions related to treatment of Bridgeport stormwater by directing roof run-off to residential rain gardens.

Annual Savings Potential by 2030 flat roof sites	**0.9 $MTCO_2e$**
Annual Savings Potential by 2030 pitched roof sites	**22 $MTCO_2e$**

WPCA annual per household savings potential average flat roof site

Electricity	23.7 kWh[346]	0.01 $MTCO_2e$[347]
Water	15,157 gallons[348]	

WPCA annual per household savings potential average pitched roof site

Electricity	24.33 kWh[349]	0.01 $MTCO_2e$[350]
Water	15,559 gallons[351]	

Implementation Summary

This action assumes installation of rain gardens at 93 properties, which have flat-roof residences and at 2,193 properties, which have pitched roof residences.

- **Sub Action 3.1** on flat roof properties can be accomplished as follows:

Implementation unit: 1 household
Implementation units needed: 93

Implementation Schedule for Sub Action 3.1 flat roofs

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0.3	0.3	0.3	0.1	1.0
No. units	28	28	28	9	93
$MTCO_2e$	0.27	0.27	0.27	0.09	0.92

Upon full implementation, **Sub Action 3.1** may offer the following savings to WPCA per year.

Electricity	2204 kWh	$330 to WPCA for water treatment
Water	1,409,583 gallons	

- **Sub Action 3.2** on pitched roof properties can be accomplished as follows:

Implementation unit: 10 households
Implementation units needed: 220

Implementation Schedule for Sub Action 3.2 pitched roofs

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0.3	0.3	0.3	0.1	1.0
No. units	66	66	66	22	220
$MTCO_2e$	6.65	6.65	6.65	2.22	22.15

Upon full implementation, Sub Action 3.2 may offer the following savings to WPCA per year.

Electricity	53,356 kWh	$8,100 to WPCA for water treatment
Water	34,121,941 gallons	

Additional Considerations

Rain gardens can play a valuable role in water management in Bridgeport by either eliminating or slowing down the flow of water to storm drain lines. A system of rain gardens provides secondary scenic benefit to neighborhoods.

On average, a 185 square foot (10 feet x 18 ½ feet) rain garden, 6 inches deep, is sufficient to capture water from an average size flat roof residential building in Bridgeport. Installation cost is approximated at $550-$925[352] plus labor (estimated at 15 man-days). On average, a 200 square foot (10 feet x 20 feet) rain garden, 6 inches deep, is sufficient to capture water from an average pitched roof residential building in Bridgeport. Installation cost is approximately $600-$1,000 plus labor (estimated at 16 man-days).[353]

Rain garden installation proposed by Sub Action 3.1 is estimated to create job potential for 5.6 fulltime equivalent work years. Rain garden installation proposed by Sub Action 3.2 is estimated to create job potential for an additional 140 fulltime equivalent work years.[354]

Rain garden installation represents a tremendous opportunity for micro-business development and/or re-entry employment. The City of Bridgeport, with assistance from EPA, provided a rain garden training workshop in the spring of 2010 through the Bridgeport Small and Minority Business Development office. Groundwork Bridgeport has taken a leadership role in stormwater education, through its 2010 summer program to mark storm drains in the city. Coupling this storm drain effort with Groundwork's traditional grounds keeping, employment training and job placement mission makes Groundwork Bridgeport a logical partner in rain garden development in Bridgeport.

- ***Sub Action 3.3 - Rain barrels at residences with flat roofs***
- ***Sub-Action 3.4 - Rain barrels at residences with pitched roofs***

  Goal: Protect water resources and reduce energy and emissions related to treatment of Bridgeport stormwater by directing roof run-off to residential rain barrels

Annual Savings Potential by 2030 for flat roofs	**0.08 $MTCO_2e$**
Annual Savings Potential by 2030 for pitched roofs	**1.96 $MTCO_2e$**

WPCA Annual Savings potential per average flat roof site

Electricity	4.3 kWh[355]	0.002 $MTCO_2e$[356]
Water	2,500 gallons[357]	

WPCA Annual Savings potential per average pitched roof site

Electricity	4.3 kWh[358]	0.002 $MTCO_2e$[359]
Water	2,500 gallons[360]	

Implementation Summary

This action assumes installation of rain barrels at 46 existing flat roof residential buildings (5% of total) and 1,097 existing pitched roof residential buildings (5% of total).[361]

- **Sub Action 3.3** on flat roof properties can be accomplished as follows:

Implementation unit:	1 household
Implementation units needed:	46

Implementation Schedule for Sub Action 3.3 flat roofs

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0.4	0.3	0.2	0.1	1.0
No. units	18	14	9	5	46
$MTCO_2e$	0.03	0.02	0.02	0.01	0.08

Upon full implementation, **Sub Action 3.3** may offer the following savings per year.

Electricity	198 kWh	$21 to utility for water supply
		$27 to WPCA for water treatment
Water	115,000 gallons	$850 to customers for water supply
		$250 to customers for utility for water treatment

This action may result in annual utility savings related to water supply and treatment per household of $24.

- **Sub Action 3.4** on pitched roof properties can be accomplished as follows:

Implementation unit: 10 households
Implementation units needed: 110

Implementation Schedule for Sub Action 3.4 pitched roofs

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0.3	0.3	0.3	0.1	1.0
No. units	33	33	33	11	110
$MTCO_2e$	0.59	0.59	0.59	0.20	1.96

Upon full implementation, **Sub Action 3.4** may offer the following savings per year.

Electricity	4,717 kWh	$20,200 to utility for water supply
		$5,900 to WPCA for water treatment
Water	2,742,500 gallons	$500 to customers for water supply
		$600 to customers for water treatment

This action may result in annual utility savings related to water supply and treatment per household of $24.

Additional Considerations

Rain barrels can sometimes be acquired for $80.00 through a special Aquarion water company program or State of Connecticut program, or for $150 without program support.

Installation of rain barrels at flat roof residential buildings is estimated to create job potential for 0.9 fulltime equivalent work years. Installation of rain barrels at pitched roof residential buildings is estimated to create job potential for 48 fulltime equivalent work years.[362]

- ***Sub Action 3.5 - Green roofs on existing flat roof commercial buildings***
- ***Sub Action 3.6 - Green roofs on new flat roof commercial buildings***

  Goal: Protect water resources and reduce energy and emissions related to treatment of Bridgeport stormwater by capturing roof run-off or reducing flow rates with green roofs at commercial buildings.

Annual Savings Potential by 2030 Existing Buildings	**23 $MTCO_2e$**
Additional Annual Savings Potential New Buildings	**4.9 $MTCO_2e$**

WPCA Annual Savings potential per green roof

Electricity	123 kWh[363]	0.05 $MTCO_2e$[364]
Water	78,570 gallons[365]	

Implementation Summary

This action assumes installation of green roofs on 460 existing commercial flat roof buildings (30% of 1,531 existing buildings) and at 96 new commercial flat roof buildings (30% of projected new buildings) under the Low Growth Scenario and High Growth Scenario combined (52 under Low Growth scenario plus 44 under High Growth scenario).[366]

- **Sub Action 3.5** for existing buildings can be accomplished as follows:

Implementation unit:	10 buildings
Implementation units needed:	46

Implementation Schedule for Sub Action 3.5 Existing buildings

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0.1	0.4	0.3	0.2	1.0
No. units	5	14	18	9	46
$MTCO_2e$	2.35	7.04	9.38	4.69	23.46

Upon full implementation, **Sub Action 3.5** may offer the following savings per year.

Electricity	56,514 kWh	$8,500 to WPCA for water treatment
Water	36,142,014 gallons	

- **Sub Action 3.6** for new buildings can be accomplished as follows:

Implementation unit:	1 building
Implementation units needed:	96

Implementation Schedule for Sub Action 3.6 new buildings

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0.1	0.3	0.4	0.2	1.0
No. units	10	29	38	19	96
$MTCO_2e$	0.49	1.47	1.96	0.98	4.90

Upon full implementation, **Sub Action 3.6** may offer the following savings per year.

Electricity	11,794 kWh	$1,800 to WPCA for water treatment
Water	7,542,681 gallons	

Additional Considerations

A Washington D.C study of green roof potential of roofs over 10,000 square feet reported a 69% reduction of water discharge from 80% extensive/20% intensive green roof cover reduced water discharge by 69%. Although coverage area was only 6% of total land cover, and total water flow involved was relatively small, in areas of heavy flooding, this small cover percentage was predicted to be valuable to flood management. Even as low as 20% roof cover was predicted to reduce CSO's in associated micro-watershed areas. In addition, UFORE modeling predicted added benefit from air quality improvement.[367]

Washington D.C., working to expand green roof coverage, has a green roof subsidy program.[368]

Labor and job potential associated with this action is attributed to an action detailed in another section of this Energy Plan.

- ***Sub Action 3.7 - Bioswales and detention/retention areas for flat roof commercial building sites***
- ***Sub Action 3.8 - Bioswales and detention/retention areas for pitched roof commercial building sites***

  Goal: Protect water resources, reduce storm flow impact, and reduce energy and emissions related to treatment of Bridgeport stormwater by capturing run-off from commercial properties in commercial detention or retention areas.

Annual Savings Potential by 2030 flat roof buildings	**6 $MTCO_2e$**
Annual Savings Potential by 2030 pitched roof buildings	**2.5 $MTCO_2e$**

WPCA Annual Savings potential per flat roof building

Electricity	189 kWh electricity[369]	0.08 MT[370]CO2e
Water	120,876 gallons[371]	

WPCA Annual Savings potential per pitched roof building

Electricity	133 kWh electricity	0.06 $MTCO_2e$
Water	85,178 gallons[372]	

Implementation Summary

This action assumes installation of vegetated retention or detention facilities to capture rainwater from 5% of existing flat roof commercial buildings (77 buildings) and 5% of existing pitched roof commercial buildings (46 buildings).[373]

- **Sub Action 3.7** flat roof buildings can be accomplished as follows:

Implementation unit:	1 building
Implementation units needed:	77

Implementation Schedule for Sub Action 3.7 flat roof building sites

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0.3	0.3	0.3	0.3	1.0
No. units	23	23	23	8	77
$MTCO_2e$	1.81	1.81	1.81	0.60	6.04

Upon full implementation, **Sub Action 3.7** flat roof building sites may offer the following savings per year.

Electricity	14,469 kWh	$2,200 to WPCA for water treatment
Water	9,253,081 gallons	

- **Sub Action 3.8** pitched roof buildings can be accomplished as follows:

Implementation unit:	1 building
Implementation units needed:	46

Implementation Schedule for Sub Action 3.8 pitched roof building sites

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0.3	0.3	0.3	0.3	1.0
No. units	14	14	14	5	46
$MTCO_2e$	0.76	0.76	0.76	0.25	2.54

Upon full implementation, **Sub Action 3.8** pitched roof building sites may offer the following savings per year.

Electricity	6,127 kWh	$925 to WPCA for water treatment
Water	3,918,196 gallons	

Additional Considerations

The City, as a property owner, has an opportunity to work with WPCA and private landowners, to create water management zones to capture or divert stormwater and help provide flood control. Flood management facilities can couple as parks and green space. Increasing numbers of cities are enabling water to become a part of their cities, and an asset, through such facilities.

A 40-foot square commercial water management area is estimated to accommodate water from a 1 inch rainfall for the average size flat roof commercial building. A 32-foot square commercial water management area is estimated to accommodate water from a 1-inch rainfall for the average size non-flat commercial building.[374]

Measures carried out under this green infrastructure action for flat roof commercial buildings are estimated to create job potential for 39 fulltime equivalent work years.[375]

Measures carried out under this green infrastructure action for non-flat roof commercial buildings are estimated to create job potential for an additional 14.7 fulltime equivalent work years.[376]

- ***Sub Action 3.9 - Vegetated or permeable pavement water management areas***
  Goal: Protect water resources, reduce storm flow impact, and reduce energy and emissions related to treatment of Bridgeport stormwater by creating water management areas to capture and detain or infiltrate street and other paved surface run-off.

Annual Savings Potential by 2030 **3.5 $MTCO_2e$**

WPCA Annual Savings potential per ½ acre

Electricity	425 kWh	0.2 $MTCO_2e$
Water	271,543 gallons	

Implementation Summary

This action assumes creation of 10 acres for water management with vegetation or permeable surface materials to reduce flow of paved surface runoff or enable water infiltration.

This action can be accomplished as follows:

Implementation unit:	½ acre sites
Implementation units needed:	20

Implementation Schedule

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0.5	0.5	0	0	1.0
No. units	10	10	0	0	20
$MTCO_2e$	1.76	1.76	0.00	0.00	3.53

Upon full implementation, this action may offer the following savings per year.

Electricity	8,492 kWh	$1,300 to WPCA for water treatment
Water	5,430,857 gallons	

Additional Considerations

Stormwater Management Regulations, in place, require on-site water control for certain new construction. The Bridgeport Building Department, WPCA, and Engineering advisor can together explore opportunities to incorporate green infrastructure incentives into Stormwater Management Regulations to encourage the creation of additional on-site water management facilities or methods. The City Department of Planning and Economic Development can assist with action item implementation by setting the tone for green building and green infrastructure development by potential property developers.

Permeable paving and porous surface materials are in place in many applications nationwide, including Bridgeport.[377] Additional demonstration pilots are being planned by the City. Particularly in Downtown, but also in other flood-prone areas, providing specific water management sites, and/or incorporating specific water management materials into sites, will prove valuable.

The City's successful efforts to install permeable surface materials can be shared with the business community through the Bridgeport Regional Business Council enabling all members, and specifically those members in the building trades, architects, engineers, landscape architects, and landscape trades, to promote similar installations on private commercial properties.

Job potential from this action item was not calculated.

- ***Sub Action 3.10 Complete streets with bioswales***
  Goal: Develop bioswales as part of complete streets to reduce storm flow impact, protect water resources, and reduce energy and emissions related to stormwater treatment .

Annual Savings Potential by 2030 **20 $MTCO_2e$**

WPCA Annual Savings potential per 20 homes (1,000 lineal feet)

Electricity	975 kWh	0.4 $MTCO_2e$
Water	623,377 gallons[378]	

Implementation Summary

This action assumes creation of complete streets, which include a four-to-six foot wide vegetative buffer along 9.29 miles (5%) of the city's roadways.

This action can be accomplished as follows:
Implementation unit: 1,000 feet street frontage (approximately 20 homes with 50 feet street frontage each)
Implementation units needed: 49[379]

Implementation Schedule

	2010-15	2015-20	2020-25	2025-30	2010 to 2030 Total
Percent	0.2	0.4	0.2	0	1.0
No. units	12	25	12	0	49
$MTCO_2e$	4.96	9.92	4.96	0.00	19.85

Upon full implementation, this action may offer the following savings per year.

Electricity	47,763 kWh	$7,200 to WPCA for water treatment
Water	30,545,455 gallons	

Additional Considerations

City streets and right-of-ways should be viewed as a resource for water management, and used to temper stormwater flow and benefit water quality in rivers and Long Island Sound.

Philadelphia, in particular, is establishing an extensive system of bioswales to assist with water management, and provides a valuable model to Bridgeport.

As the WPCA works with the State of Connecticut in creating a Long Term Control Plan, green infrastructure inclusion will be essential. Baseline study is needed to quantify potential economic and water quality impact of wide scale implementation, but demonstration complete streets can be put in place immediately. The City can easily incorporate bioswales into ongoing street maintenance programs.

Job potential from this action item was not calculated.

- ***Sub Action 3.11 - Green Infrastructure Inclusion in Long Term Stormwater Management Control Plan***
  Goal: Incorporate green infrastructure and LID in the city's Long Term Control Plan to protect water resources, reduce storm flow impact, and reduce energy and emissions related to stormwater.

Annual Savings Potential by 2030 **$MTCO_2e$ not quantified**

Implementation Summary and Considerations

As the WPCA works with the State of Connecticut in creating a Long Term Control Plan, LID and green infrastructure inclusion will be essential. Baseline study is needed to more specifically quantify potential economic, water control and water quality impact of wide-scale implementation of measures such as these, but savings over full system separation alone are expected to be worthwhile.

The Environmental Protection Agency encourages incorporation of green infrastructure as "prominent components" of Combined and Separate Sewer Overflow (CSO & SSO) and municipal stormwater (MS4) programs.[380]

The City can expand its green infrastructure demonstration measures, and establish policies and procedures relative to the public realm, but must also work strongly with private property owners in this effort, since significant property is privately-owned.

As noted earlier in this Bridgeport Energy Plan, Stormwater Management Regulations, in place, regulate certain new construction. The Bridgeport Building Department, WPCA, and Engineering advisor can together explore opportunities to incorporate green infrastructure incentives into Stormwater Management Regulations to encouraged additional on-site water management.

The City has created permeable paving and porous surface materials applications in several locations in Bridgeport. Additional demonstration pilots are being planned. These can serve a role in educating the private sector to potential application on private property, particularly in Downtown, but also in other flood-prone areas.

Leader disconnect programs are helping many cities reduce storm load. The City, WPCA and Energy Improvement District can jointly explore advantages and disadvantages of pursuing this option in Bridgeport, and establishing green infrastructure, which enables infiltration, as an alternative, and as an opportunity for inclusion in Long Term Water Control Planning.

Vegetative cover analysis can be included in City and WPCA efforts associated with the development of a Long Term Control Plan. UFORE and/or UTC analysis can assist the City to inventory vegetative cover and identify opportunities for vegetative and green infrastructure enhancement, which will dovetail with hard infrastructure modifications.

Green roof development will depend on participation by private property ownership. Bridgeport's Energy Improvement District and Bridgeport Regional Business Council can assist the City in providing the outreach and financing mechanisms needed to assimilate commercial property green roof development into Long Term Control Planning.

A potential green infrastructure demonstration project is currently under study at Seaside Village. Upon completion of this study, this site may serve to illustrate the potential supportive roles that private property owners and the City can play in creating green infrastructure measures, in a slightly larger geographic application, to complement WPCA sewer separation measures.

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Appendix: Gallons of Water Conserved and/or Diverted from WPCA.

REFERENCES

[1] Bridgeport's GHG inventory was completed using Clean Air and Climate Protection (CACP) software, developed by the National Association of Clean Air Agencies (formerly STAPPA and ALAPCO), ICLEI-Local Governments for Sustainability (formerly International Cities for Local Environmental Action (ICLEI)), and Torrie Smith Associates Inc. Minor updates were made to the plan in 2009 to reflect input of additional information.

[2] Bridgeport is predicted to add 14,916 jobs between 2007 and 2030 and increase its household population by more than 7,600 (RPA, based on Rodriguez, Orlando, 2007, Bridgeport, CT Population Projection from 2010 to 2030 by Age, Ethnicity and Sex Distributions, Connecticut State Data Center, University of Connecticut, Storrs, Connecticut, and assuming linear growth between 2005 and 2010).

[3] 2010 Connecticut Energy Advisory Board Procurement Plan, CEAB Technical Paper: Emerging Technologies, http://www.ctenergy.org/pdf/2010CEABPPPart4b1.pdf.

[4] Aquarion reports 2010 average residential customer usage in Bridgeport of 105,000 gallons of water, which is down from 2007 average residential customer usage of 111,200 gallons.

[5] City of Bridgeport and The Institute for Sustainable Energy at Eastern Connecticut State University, February 2010, Bridgeport City Buildings; Facilities Benchmarking Analysis Utilizing the US Environmental Protection Agency's Energy Star - Portfolio Manager.

[6] Upon recommendation of ICLEI, Bridgeport GHG Inventory conducted for calendar year 2007 used Egrid Subregion 1 – NPCC New England coefficient figures for 2004 as follows: CO2 908.9 lbs/MWH; N20 0.015 lbs/MWH; CH4 0.080 lbs/MWH and criteria air pollutants as follows: NOX 0.677 lbs/MWH; SOX 1.262 lbs/MWH; CO 1.216 lbs/MWH; VOC 0.136 lbs/MWH; PM10 0.982 lbs/MWH. Electricity default metric tons/kWh is based on Bridgeport inventory, which had input of 762,419,176 total kWh community-wide and reported 316,511 $MTCO_2e$ of electricity-related emissions community-wide for average of 0.000415141 $MTCO_2e$/kWh.

[7] Bridgeport GHG Inventory for calendar year 2007 had input of 3,998,557 thousand cubic feet total natural gas community-wide and reported 228,616 $MTCO_2e$ of natural gas-related emissions community-wide for an average of 0.057175 $MTCO_2e$/thousand cf.

[8] Dollar savings are calculated using 2010 utility costs of $0.24/kWh electricity (includes all fees); $9.18/thousand cf natural gas for commercial/industrial and $14.81/thousand cf natural gas for residential; $2.65/ gallon #2 light fuel oil; $3.00/gallon gasoline/diesel (assumes 1 average price per gallon); $0.00735/ gallon water residential supply and $0.005/gallon water commercial/industrial supply; $0.002166/gallon cost to residents and businesses for water treatment; $0.00018/gallon cost to utility associated with electricity to supply water; $0.000234/gallon cost associated with electricity used to WPCA to treat water.

[9] The Institute for Sustainable Energy at Eastern Connecticut State University, 2010, Bridgeport Public Schools; Facilities Benchmarking Analysis Utilizing the US Environmental Protection Agency's Energy Star - Portfolio Manager.

[10] Upon recommendation of ICLEI, Bridgeport GHG Inventory conducted for calendar year 2007 used Egrid Subregion 1 – NPCC New England coefficient figures for 2004 as follows: CO2 908.9 lbs/MWH; N20 0.015 lbs/MWH; CH4 0.080 lbs/MWH and criteria air pollutants as follows: NOX 0.677 lbs/MWH; SOX 1.262 lbs/MWH; CO 1.216 lbs/MWH; VOC 0.136 lbs/MWH; PM10 0.982 lbs/MWH. Electricity default from metric tons/kWh based on Bridgeport inventory, which had input of 762,419,176 total kWh community-wide and reported 316,511 $MTCO_2e$ of electricity-related emissions community-wide for average of 0.000415141 $MTCO_2e$/kWh.

[11] Bridgeport GHG Inventory for calendar year 2007 had input of 3,998,557 thousand cubic feet total natural gas community-wide and reported 228,616 $MTCO_2e$ of natural gas-related emissions community-wide for average of 0.057175 $MTCO_2e$/thousand cf.

[12] Dollar savings are calculated using 2010 utility costs of $0.24/kWh electricity (includes all fees); $9.18/thousand cf natural gas for commercial/industrial and $14.81/thousand cf natural gas for residential; $2.65/ gallon #2 light fuel oil; $3.00/gallon gasoline/diesel (assumes 1 average price per gallon); $0.00735/ gallon water residential supply and $0.005/gallon water commercial/industrial supply; $0.002166/gallon cost to residents and businesses for water treatment; $0.00018/gallon cost to utility associated with electricity to supply water; $0.000234/gallon cost associated with electricity used to WPCA to treat water.

[13] Energy inputs and emissions outputs from Bridgeport 2007 GHG Inventory for commercial sector are as follows:

Electricity	432,003,521 kWh	179,342	$MTCO_2e$
Light Fuel Oil	4,942 thousand gallons	51,856	$MTCO_2e$
Natural Gas	2,300,709 thousand cf	131,542	$MTCO_2e$
Total emissions		362,740	$MTCO_2e$
25% reduction goal			
Electricity	108,000,880 kWh	44.835.50	$MTCO_2e$
Light Fuel Oil	1235.50 thousand gallons	12,964	$MTCO_2e$
Natural Gas	575177.25 thousand gallons	32.885.50	$MTCO_2e$
Total C/I building emissions reduction goal		90,685	$MTCO_2e$

[14] Per building average annual savings potential derived from 2010 Electric and Natural Gas Conservation and Load Management Plan. UI Small business energy advantage savings per project of 23,314kWh/yr calculated from 2010 projection data in The Connecticut Light and Power Company, The United Illuminating Company, Yankee Gas Services Company, Connecticut Natural Gas Corporation and The Southern Connecticut Gas Company, Docket No. 09-10-10, Docket No. 08-10-02, October 1, 2009, 2010 Electric and Natural Gas Conservation and Load Management Plan; page 192: UI 2010 goal of 11,657,000 kWh savings/500 projects = 23,314 kWh savings/project/year.

[15] Upon recommendation of ICLEI, Bridgeport GHG Inventory conducted for calendar year 2007 used Egrid Subregion 1 – NPCC New England coefficient figures for 2004 as follows: CO2 908.9 lbs/MWH; N20 0.015 lbs/MWH; CH4 0.080 lbs/MWH and criteria air pollutants as follows: NOX 0.677 lbs/MWH; SOX 1.262 lbs/MWH; CO 1.216 lbs/MWH; VOC 0.136 lbs/MWH; PM10 0.982 lbs/MWH. Electricity default from metric tons/kWh based on Bridgeport inventory, which had input of 762,419,176 total kWh community-wide and reported 316,511 $MTCO_2e$ of electricity-related emissions community-wide for average of 0.000415141 $MTCO_2e$/kWh.

[16] Dollar savings are calculated using 2010 utility costs of $0.24/kWh electricity (includes all fees); $9.18/thousand cf natural gas for commercial/industrial and $14.81/thousand cf natural gas for residential; $2.65/ gallon #2 light fuel oil; $3.00/gallon gasoline/diesel (assumes 1 average price per gallon); $0.00735/ gallon water residential supply and $0.005/gallon water commercial/industrial supply; $0.002166/gallon cost to residents and businesses for water treatment; $0.00018/gallon cost to utility associated with electricity to supply water; $0.000234/gallon cost associated with electricity used to WPCA to treat water.

[17] See Appendix for financing options reported by the Connecticut Energy Advisory Board in its 2010 report.

[18] Job potential estimate is based on the following: average job creation for energy efficiency projects is 9.1 job-years per $1 million spent (Navigant Consulting, CT Renewable Energy / Energy Efficiency Economy Baseline Study, Phase 1, March 27, 2009). This Bridgeport Energy Plan assumes average investment equals $25,000 per job site. Job creation equals 0.2275 job-years per site.

[19] UI Energy Opportunities savings per project of 97,478 kWh per year calculated from 2010 projection data in The Connecticut Light and Power Company, The United Illuminating Company, Yankee Gas Services Company, Connecticut Natural Gas Corporation and The Southern Connecticut Gas Company, Docket No. 09-10-10, Docket No. 08-10-02, October 1, 2009, 2010 Electric and Natural Gas Conservation and Load Management Plan; Page 177: UI 2010 goal of 17,058,612 kWh savings/175 projects (including 10 comprehensive projects) = 97,478 kWh/project

[20] Upon recommendation of ICLEI, Bridgeport GHG Inventory conducted for calendar year 2007 used Egrid Subregion 1 – NPCC New England coefficient figures for 2004 as follows: CO2 908.9 lbs/MWH; N20 0.015 lbs/MWH; CH4 0.080 lbs/MWH and criteria air pollutants as follows: NOX 0.677 lbs/MWH; SOX 1.262 lbs/MWH; CO 1.216 lbs/MWH; VOC 0.136 lbs/MWH; PM10 0.982 lbs/MWH. Electricity default from metric tons/kWh based on Bridgeport inventory, which had input of 762,419,176 total kWh community-wide and reported 316,511 $MTCO_2e$ of electricity-related emissions community-wide for average of 0.000415141 $MTCO_2e$/kWh.

[21] SCG Energy Opportunities savings per project of 8,504 ccf per year calculated from 2010 projection data in The Connecticut Light and Power Company, The United Illuminating Company, Yankee Gas Services Company, Connecticut Natural Gas Corporation and The Southern Connecticut Gas Company, Docket No. 09-10-10, Docket No. 08-10-02, October 1, 2009, 2010 Electric and Natural Gas Conservation and Load Management Plan; Page 181: SCG 2010 goal of 195,604 ccf annual savings/23 projects = 8,504 ccf/project

[22] Bridgeport GHG Inventory for calendar year 2007 had input of 3,998,557 thousand cubic feet total natural gas community-wide and reported 228,616 $MTCO_2e$ of natural gas-related emissions community-wide for average of 0.057175 $MTCO_2e$/thousand cf.

[23] Dollar savings are calculated using 2010 utility costs of $0.24/kWh electricity (includes all fees); $9.18/thousand cf natural gas for commercial/industrial and $14.81/thousand cf natural gas for residential; $2.65/ gallon #2 light fuel oil; $3.00/gallon gasoline/diesel (assumes 1 average price per gallon); $0.00735/ gallon water residential supply and $0.005/gallon water commercial/industrial supply; $0.002166/gallon cost to residents and businesses for water treatment; $0.00018/gallon cost to utility associated with electricity to supply water; $0.000234/gallon cost associated with electricity used to WPCA to treat water.

[24] See Appendix for financing options reported by the Connecticut Energy Advisory Board in its 2010 report.

[25] Job potential estimate is based on the following: average job creation for energy efficiency projects is 9.1 job-years per $1 million spent (Navigant Consulting, CT Renewable Energy / Energy Efficiency Economy Baseline Study, Phase 1, March 27, 2009). This Bridgeport Energy Plan assumes average investment equals $800,000 per job site. Job creation equals 7.28 job-years per site.

[26] Richard Carroll, Siemens – guaranteed savings for 2,500 units combined.

[27] Dollar savings are calculated using 2010 utility costs of $0.24/kWh electricity (includes all fees); $9.18/thousand cf natural gas for commercial/industrial and $14.81/thousand cf natural gas for residential; $2.65/ gallon #2 light fuel oil; $3.00/gallon gasoline/diesel (assumes 1 average price per gallon); $0.00735/ gallon water residential supply and $0.005/gallon water commercial/industrial supply; $0.002166/gallon cost to residents and businesses for water treatment; $0.00018/gallon cost to utility associated with electricity to supply water; $0.000234/gallon cost associated with electricity used to WPCA to treat water.

[28] 2007 Households derived from CT State Data Center: Rodriguez, Orlando, 2007; Bridgeport, CT Population Projection from 2010 to 2030 by Age, Ethnicity and Sex Distributions, Connecticut State Data Center, University of Connecticut, Storrs, Connecticut, and assuming linear growth between 2005 and 2010.

[29] Home Energy Solutions savings per household (not building) of 1,070 kWh per year calculated from 2010 projection data in The Connecticut Light and Power Company, The United Illuminating Company, Yankee Gas Services Company, Connecticut Natural Gas Corporation and The Southern Connecticut Gas Company, Docket No. 09-10-10, Docket No. 08-10-02, October 1, 2009, 2010 Electric and Natural Gas Conservation and Load Management Plan; page 114: UI 2010 goal of 4,324,000 kWh savings / 4043 projects = 1,070 kWh/project/year

[30] Upon recommendation of ICLEI, Bridgeport GHG Inventory conducted for calendar year 2007 used Egrid Subregion 1 – NPCC New England coefficient figures for 2004 as follows: CO2 908.9 lbs/MWH; N20 0.015 lbs/MWH; CH4 0.080 lbs/MWH and criteria air pollutants as follows: NOX 0.677 lbs/MWH; SOX 1.262 lbs/MWH; CO 1.216 lbs/MWH; VOC 0.136 lbs/MWH; PM10 0.982 lbs/MWH. Electricity default from metric tons/kWh based on Bridgeport inventory, which had input of 762,419,176 total kWh community-wide and reported 316,511 $MTCO_2e$ of electricity-related emissions community-wide for average of 0.000415141 $MTCO_2e$/kWh.

[31] Home Energy Solutions gas savings per household (not building) per year- 65 ccf calculated from 2010 projection data in The Connecticut Light and Power Company, The United Illuminating Company, Yankee Gas Services Company, Connecticut Natural Gas Corporation and The Southern Connecticut Gas Company, Docket No. 09-10-10, Docket No. 08-10-02, October 1, 2009, 2010 Electric and Natural Gas Conservation and Load Management Plan; Page 117: SCG 2010 goal of 123,219 ccf savings / 1,895 sites = 65 ccf savings/project/year

[32] Bridgeport GHG Inventory for calendar year 2007 had input of 3,998,557 thousand cubic feet total natural gas community-wide and reported 228,616 $MTCO_2e$ of natural gas-related emissions community-wide for average of 0.057175 $MTCO_2e$/thousand cf.

[33] Home Energy Solutions gallons light fuel oil per year per residence assumes 15% savings on 375 gallons/household used in Bridgeport GHG inventory or 56.25 gallons.

[34] Bridgeport GHG Inventory for calendar year 2007 had input of 9,585 thousand gallons of light fuel oil community wide and reported 100,588 $MTCO_2e$ of light fuel oil-related emissions community wide for average of 9.367 $MTCO_2e$/thousand gallons of fuel oil.

[35] Dollar savings are calculated using 2010 utility costs of $0.24/kWh electricity (includes all fees); $9.18/thousand cf natural gas for commercial/industrial and $14.81/thousand cf natural gas for residential; $2.65/ gallon #2 light fuel oil; $3.00/gallon gasoline/diesel (assumes 1 average

price per gallon); $0.00735/ gallon water residential supply and $0.005/gallon water commercial/industrial supply; $0.002166/gallon cost to residents and businesses for water treatment; $0.00018/gallon cost to utility associated with electricity to supply water; $0.000234/gallon cost associated with electricity used to WPCA to treat water.

[36] See Appendix for CEAB analysis of numerous potential funding mechanisms.

[37] Labor estimate assumes 2 installers for a half day per household, which equals 1 man day per job.

[38] 47,543 households derived from Connecticut State Data Center data: RPA derived from Rodriguez, Orlando, 2007; Bridgeport, CT Population Projection from 2010 to 2030 by Age, Ethnicity and Sex Distributions, Connecticut State Data Center, University of Connecticut, Storrs, Connecticut, and assuming linear growth between 2005 and 2010.

[39] Income eligible residential WRAP/UI Helps program electricity savings per household per year = 1,031 kWh calculated from 2010 projection data in The Connecticut Light and Power Company, The United Illuminating Company, Yankee Gas Services Company, Connecticut Natural Gas Corporation and The Southern Connecticut Gas Company, Docket No. 09-10-10, Docket No. 08-10-02, October 1, 2009, 2010 Electric and Natural Gas Conservation and Load Management Plan; Page 134: UI 2010 goal of 7,115,000 kWh savings / 6,093 sites = 1,031 kWh/site/year

[40] Upon recommendation of ICLEI, Bridgeport GHG Inventory conducted for calendar year 2007 used Egrid Subregion 1 – NPCC New England coefficient figures for 2004 as follows: CO2 908.9 lbs/MWH; N20 0.015 lbs/MWH; CH4 0.080 lbs/MWH and criteria air pollutants as follows: NOX 0.677 lbs/MWH; SOX 1.262 lbs/MWH; CO 1.216 lbs/MWH; VOC 0.136 lbs/MWH; PM10 0.982 lbs/MWH. Electricity default from metric tons/kWh based on Bridgeport inventory, which had input of 762,419,176 total kWh community-wide and reported 316,511 $MTCO_2e$ of electricity-related emissions community-wide for average of 0.000415141 $MTCO_2e$/kWh.

[41] Income eligible SCG Limited Income Weatherization and Heating System residential ccf gas savings per residence per year = 123.98 (round to 124) ccf calculated from 2010 projection data in The Connecticut Light and Power Company, The United Illuminating Company, Yankee Gas Services Company, Connecticut Natural Gas Corporation and The Southern Connecticut Gas Company, Docket No. 09-10-10, Docket No. 08-10-02, October 1, 2009, 2010 Electric and Natural Gas Conservation and Load Management Plan; Page 138: SCG 2010 goal of 105,631 ccf / 852 sites = 124 ccf/site/year

[42] Bridgeport GHG Inventory for calendar year 2007 had input of 3,998,557 thousand cubic feet total natural gas community-wide and reported 228,616 $MTCO_2e$ of natural gas-related emissions community-wide for average of 0.057175 $MTCO_2e$/thousand cf.

[43] Income Eligible gallons light fuel oil per year per household assumes 15% savings on 375 gallons/household used in Bridgeport GHG inventory or 56.25 gallons.

[44] Bridgeport GHG Inventory for calendar year 2007 had input of 9,585 thousand gallons of light fuel oil community-wide and reported 100,588 $MTCO_2e$ of light fuel oil-related emissions community-wide for average of 9.367 $MTCO_2e$/thousand gallons of fuel oil.

[45] Dollar savings are calculated using 2010 utility costs of $0.24/kWh electricity (includes all fees); $9.18/thousand cf natural gas for commercial/industrial and $14.81/thousand cf natural gas for residential; $2.65/ gallon #2 light fuel oil; $3.00/gallon gasoline/diesel (assumes 1 average price per gallon); $0.00735/ gallon water residential supply and $0.005/gallon water commercial/industrial supply; $0.002166/gallon cost to residents and businesses for water treatment; $0.00018/gallon cost to utility associated with electricity to supply water; $0.000234/gallon cost associated with electricity used to WPCA to treat water.

[46] Center for Neighborhood Technology, 2008, Chicago Greenhouse Gas Emissions: An Inventory, Forecast, and Mitigation Analysis for Chicago and the Metropolitan Region; An assessment prepared for the City of Chicago; http://www.chicagoclimateaction.org/filebin/pdf/FINALALL091708_1-118.pdf

[47] See Appendix for CEAB analysis of numerous potential funding mechanisms.

[48] Labor estimate assumes 2 installers for a half day per household, which equals 1 man day per job.

[49] Assumes a mid-range change from 15 to 27 R value (range is 0 to 45).

[50]Assumes installation of ceiling insulation with new R value of 27 and old R value of 15 (a mid-range shift in the full range of 0 to 45 R values). UI and CL&P Program Savings Documentation for 2010 Program Year, page 165 notes savings from Installation of Ceiling Insulations (HES and Low Income) as

noted equals 78 kWh savings/year per 100 square feet for Electric Resistance Heat. The average residential building footprint in Bridgeport is 1,064 square feet (Bridgeport Tax Assessor information). 78 kWh/100 square feet X 1,064 square feet = 829.92 kWh/year/building.

[51] Upon recommendation of ICLEI, Bridgeport GHG Inventory conducted for calendar year 2007 used Egrid Subregion 1 – NPCC New England coefficient figures for 2004 as follows: CO2 908.9 lbs/MWH; N20 0.015 lbs/MWH; CH4 0.080 lbs/MWH and criteria air pollutants as follows: NOX 0.677 lbs/MWH; SOX 1.262 lbs/MWH; CO 1.216 lbs/MWH; VOC 0.136 lbs/MWH; PM10 0.982 lbs/MWH. Bridgeport inventory had input of 762,419,176 total kWh community-wide and reported 316,511 $MTCO_2e$ of electricity-related emissions for community-wide average of 0.000415141 $MTCO_2e$/kWh.Ceiling insulation installation emissions savings from electricity savings $MTCO_2e$/100 square feet electric heat = (829.92 kWh/year/building) X 0.000415141 = 0.032380978 metric tons/100 square feet. Average residential building footprint = 1,064 square feet. Emissions savings per building = (0.032380978 metric tons/100 square feet) X (1,064 square feet/building) = 0.344533604 $MTCO_2e$ per building for electric heat.

[52]Assumes installation of ceiling insulation with new R value of 27 and old R value of 15 (a mid-range shift in the full range of 0 to 45 R values). UI and CL&P Program Savings Documentation for 2010 Program Year, page 167 notes savings from Installation of Ceiling Insulations (HES and Low Income) as described equals 3.5 therms per year per 100 square feet in gas savings if gas heated. The average residential building footprint in Bridgeport is 1,064 square feet (Bridgeport Tax Assessor information). 1 therm = 100 cf gas. (0.35 thousand cf gas/100 square feet) X (1064 square feet/building) = 3.724 thousand cf gas/year/building savings.

[53] Bridgeport GHG Inventory for calendar year 2007 had input of 3,998,557 thousand cubic feet of natural gas community-wide and reported 228,616 $MTCO_2e$ of natural gas-related emissions community-wide for average of 0.057175 $MTCO_2e$/thousand cf. Using this conversion, (3.724 thousand cf gas) X (0.057175 $MTCO_2e$/thousand cf) = 0.212918692 $MTCO_2e$ per building per year.

[54] Assumes installation of ceiling insulation with new R value of 27 and old R value of 15 (a mid-range shift in the full range of 0 to 45 R values). UI and CL&P Program Savings Documentation for 2010 Program Year, page 166 notes savings from Installation of Ceiling Insulations (HES and Low Income) as described equals 2.5 gallons heating fuel oil /year per 100 square feet for oil-heated household. The average residential building footprint in Bridgeport is 1,064 square feet (Bridgeport Tax Assessor information). (1,064 square feet/building) X (2.5 gallons/100 square feet) = 0.0266 thousand gallons oil/building.

[55] Bridgeport GHG Inventory for calendar year 2007 had input of 9,585 thousand gallons of light fuel oil community-wide and reported 100,588 $MTCO_2e$ of light fuel oil-related emissions community-wide for average of 9.367 $MTCO_2e$/thousand gallons of fuel oil. Using this conversion: (0.0266 thousand gallons oil/building) X (9.367 $MTCO_2e$/thousand gallons) =0.2491622 $MTCO_2e$/building annual savings.

[56] Total emissions savings per building assumes 50/50 split of oil and gas heating units and disregards electrical heat to reflect heating split of 47% oil heating and 52 % gas heating as reported from Bridgeport Tax Assessor data.

[57] Total residential buildings (not households) from Bridgeport Tax Assessor equal 22,866. This number excludes condominiums.

[58] Dollar savings are calculated using 2010 utility costs of $0.24/kWh electricity (includes all fees); $9.18/thousand cf natural gas for commercial/industrial and $14.81/thousand cf natural gas for residential; $2.65/ gallon #2 light fuel oil; $3.00/gallon gasoline/diesel (assumes 1 average price per gallon); $0.00735/ gallon water residential supply and $0.005/gallon water commercial/industrial supply; $0.002166/gallon cost to residents and businesses for water treatment; $0.00018/gallon cost to utility associated with electricity to supply water; $0.000234/gallon cost associated with electricity used to WPCA to treat water.

[59] See Appendix for CEAB analysis of numerous potential funding mechanisms.

[60] Job development estimate assumes labor of 2 man-days per job.

[61] Assumes insulation creates 10% reduction in average household energy demand. This assumes heating and cooling energy equals 56% of total building energy use (U.S. DOE, Home Energy tips, http://www.energy.gov/heatingcooling.htm). Assumes insulation creates savings of between 15% and 20% of heating and cooling energy demand. Residential energy demand from Bridgeport 2007 GHG Inventory data is as follows: residential electricity consumption equaled 330,415,655 kWh; residential light fuel oil consumption equaled 4,643 thousand gallons; and residential natural gas consumption equaled 1,697,848 thousand cf. Per household average based on 47,543 Bridgeport households (RPA derived from Rodriguez, Orlando, 2007. Bridgeport, CT Population Projection from 2010 to 2030 by Age, Ethnicity and Sex Distributions, Connecticut State Data Center, University of Connecticut, Storrs, Connecticut, and assuming linear growth between 2005 and 2010).

[62] Residential building emissions from 2007 Bridgeport GHG Inventory are 137,169 $MTCO_2e$ for electricity, 48,732 $MTCO_2e$ for light fuel oil, and 97,074 $MTCO_2e$ for natural gas. Per household averages are based on 47,543 Bridgeport households (RPA derived from Rodriguez, Orlando, 2007; Bridgeport, CT Population Projection from 2010 to 2030 by Age, Ethnicity and Sex Distributions, Connecticut State Data Center, University of Connecticut, Storrs, Connecticut, and assuming linear growth between 2005 and 2010).

[63] Dollar savings are calculated using 2010 utility costs of $0.24/kWh electricity (includes all fees); $9.18/thousand cf natural gas for commercial/industrial and $14.81/thousand cf natural gas for residential; $2.65/ gallon #2 light fuel oil; $3.00/gallon gasoline/diesel (assumes 1 average price per gallon); $0.00735/ gallon water residential supply and $0.005/gallon water commercial/industrial supply; $0.002166/gallon cost to residents and businesses for water treatment; $0.00018/gallon cost to utility associated with electricity to supply water; $0.000234/gallon cost associated with electricity used to WPCA to treat water.

[64]Assumes installation of 4 cfl bulbs with each having the electricity savings averaged between expected savings of a hallway bulb and expected savings of a study/den bulb, or 61.3413 kWh per year. CFL in a study/den has assumed average savings of 48.8 kWh/year (calculated based on UI and CL&P Program Savings Documentation for 2010 Program Year, pages 80-81: Annual Gross Energy Savings for a 15 watt CFL with 2.97 hours/day usage (average for Den/Office, kitchen, Living Room, Dining Room) with net realization of 81% (UI and CL&P Program Savings Documentation for 2010 Program Year, page 210: Net Realization for General Service CFL Bulbs, Non-General Service CFL Bulbs, and CFL Giveaway Programs each = 81%) resulting in average savings of 39.53 kWh per year per study/den bulb. CFL in a hallway has assumed average savings of 102.66 kWh/year (calculated based on UI and CL&P Program Savings Documentation for 2010 Program Year, pages 80-81: Annual Gross Energy Savings for 15 watt CFL with 6.25 hours/day usage (average for hallway) = (3 incandescent to CFL wattage factor)(15 watts/bulb)(6.25 hours/day)(365 days/year) / 1000 = 102.66 kWh) with a net realization of 81% (UI and CL&P Program Savings Documentation for 2010 Program Year, page 210: Net Realization for General Service CFL Bulbs, Non-General Service CFL Bulbs, and CFL Giveaway Programs each) resulting in (81%)(102.66) = 83.15 kWh/year savings per year per hallway bulb.

[65] Emissions calculated based on 2007 Bridgeport GHG Inventory average emissions per kilowatt hour. Upon recommendation of ICLEI, Bridgeport GHG Inventory conducted for calendar year 2007 used Egrid Subregion 1 – NPCC New England coefficient figures for 2004 as follows: CO2 908.9 lbs/MWH; N20 0.015 lbs/MWH; CH4 0.080 lbs/MWH and criteria air pollutants as follows: NOX 0.677 lbs/MWH; SOX 1.262 lbs/MWH; CO 1.216 lbs/MWH; VOC 0.136 lbs/MWH; PM10 0.982 lbs/MWH. Bridgeport inventory had input of 762,419,176 total kWh community-wide and reported 316,511 $MTCO_2e$ of electricity-related emissions for community-wide average of 0.000415141 $MTCO_2e$/kWh. Emissions savings calculated based upon this coefficient equal 0.0164096832276304 $MTCO_2e$ per study bulb and 0.0345208622981257 $MTCO_2e$ per hallway bulb. This Bridgeport Energy Plan assumes 4 bulbs, with each having average of the two emissions or 4 (0.025465273 $MTCO_2e$) equals 0.101861091 $MTCO_2e$ for installation of 4 cfl bulbs.

[66] Household number based on Connecticut State Data Center data (Rodriguez, Orlando, 2007; Bridgeport, CT Population Projection from 2010 to 2030 by Age, Ethnicity and Sex Distributions, Connecticut State Data Center, University of Connecticut, Storrs, Connecticut, and assuming linear growth between 2005 and 2010).

[67] Dollar savings are calculated using 2010 utility costs of $0.24/kWh electricity (includes all fees); $9.18/thousand cf natural gas for commercial/industrial and $14.81/thousand cf natural gas for residential; $2.65/ gallon #2 light fuel oil; $3.00/gallon gasoline/diesel (assumes 1 average price per gallon); $0.00735/ gallon water residential supply and $0.005/gallon water commercial/industrial supply; $0.002166/gallon cost to residents and businesses for water treatment; $0.00018/gallon cost to utility associated with electricity to supply water; $0.000234/gallon cost associated with electricity used to WPCA to treat water.

[68] Connecticut Climate Change website home page for homes and individuals; Shining Solutions page; http://www.shiningsolutionsfundraiser.com/fqs.html

[69] Center for Neighborhood Technology, 2008, Chicago Greenhouse Gas Emissions: An Inventory, Forecast, and Mitigation Analysis for Chicago and the Metropolitan Region; An assessment prepared for the City of Chicago http://www.chicagoclimateaction.org/filebin/pdf/FINALALL091708_1-118.pdf).

[70] The Connecticut Light and Power Company, The United Illuminating Company, Yankee Gas Services Company, Connecticut Natural Gas Corporation and The Southern Connecticut Gas Company, Docket No. 09-10-10, Docket No. 08-10-02, October 1, 2009, 2010 Electric and Natural Gas Conservation and Load Management Plan; Page 56.

[71] Assumes refrigerator trade in for Energy Star, Low Income kWh savings/unit/year (20% savings) as noted in UI and CL&P Program Savings Documentation for 2010 Program Year, pages 134-136: Refrigerator Retirement- for Low Income annual difference between old and new Energy Star

2008 of 24 kWh /year. Note: this Bridgeport Energy Plan uses this single year figure for all annual savings figures, and does not include a separate early retirement savings.

[72] Upon recommendation of ICLEI, Bridgeport GHG Inventory conducted for calendar year 2007 used Egrid Subregion 1 – NPCC New England coefficient figures for 2004 as follows: CO2 908.9 lbs/MWH; N20 0.015 lbs/MWH; CH4 0.080 lbs/MWH and criteria air pollutants as follows: NOX 0.677 lbs/MWH; SOX 1.262 lbs/MWH; CO 1.216 lbs/MWH; VOC 0.136 lbs/MWH; PM10 0.982 lbs/MWH. Bridgeport inventory had input of 762,419,176 total kWh community-wide and reported 316,511 $MTCO_2e$ of electricity-related emissions for community-wide average of 0.000415141 $MTCO_2e$/kWh. Emissions savings calculated based upon this coefficient.

[73] Dollar savings are calculated using 2010 utility costs of $0.24/kWh electricity (includes all fees); $9.18/thousand cf natural gas for commercial/industrial and $14.81/thousand cf natural gas for residential; $2.65/ gallon #2 light fuel oil; $3.00/gallon gasoline/diesel (assumes 1 average price per gallon); $0.00735/ gallon water residential supply and $0.005/gallon water commercial/industrial supply; $0.002166/gallon cost to residents and businesses for water treatment; $0.00018/gallon cost to utility associated with electricity to supply water; $0.000234/gallon cost associated with electricity used to WPCA to treat water.

[74] Some sources report replacing a 10-year-old refrigerator can save $40 annually (see Center for Neighborhood Technology, 2008, Chicago Greenhouse Gas Emissions: An Inventory, Forecast, and Mitigation Analysis for Chicago and the Metropolitan Region; An assessment prepared for the City of Chicago http://www.chicagoclimateaction.org/filebin/pdf/FINALALL091708_1-118.pdf). This Bridgeport Energy Plan estimates the lower $6 annual utility savings based on calculations described above.

[75] Center for Neighborhood Technology, 2008, Chicago Greenhouse Gas Emissions: An Inventory, Forecast, and Mitigation Analysis for Chicago and the Metropolitan Region; An assessment prepared for the City of Chicago, http://www.chicagoclimateaction.org/filebin/pdf/FINALALL091708_1-118.pdf).

[76] Lowe's, www.lowes.com, as cited in Center for Neighborhood Technology, 2008, Chicago Greenhouse Gas Emissions: An Inventory, Forecast, and Mitigation Analysis for Chicago and the Metropolitan Region; An assessment prepared for the City of Chicago http://www.chicagoclimateaction.org/filebin/pdf/FINALALL091708_1-118.pdf).

[77] This employment opportunity calculation assumes 2 installers for ¼ day, or 0.5 man-days per refrigerator installation.

[78] Assumes freezer trade in for energy Star, Low Income kWh savings/unit/year as noted in UI and CL&P Program Savings Documentation for 2010 Program Year, pages 137-138: Freezer Retirement- for Low Income annual difference between old and new Energy Star 2008 of 36kWh /year. Note: this Bridgeport Energy Plan uses this single year figure for all annual savings figures, and does not include a separate early retirement savings.

[79] Upon recommendation of ICLEI, Bridgeport GHG Inventory conducted for calendar year 2007 used Egrid Subregion 1 – NPCC New England coefficient figures for 2004 as follows: CO2 908.9 lbs/MWH; N20 0.015 lbs/MWH; CH4 0.080 lbs/MWH and criteria air pollutants as follows: NOX 0.677 lbs/MWH; SOX 1.262 lbs/MWH; CO 1.216 lbs/MWH; VOC 0.136 lbs/MWH; PM10 0.982 lbs/MWH. Bridgeport inventory had input of 762,419,176 total kWh community-wide and reported 316,511 $MTCO_2e$ of electricity-related emissions for community-wide average of 0.000415141 $MTCO_2e$/kWh. Emissions savings calculated based upon this coefficient.

[80] Rounding accounts for difference.

[81] Dollar savings are calculated using 2010 utility costs of $0.24/kWh electricity (includes all fees); $9.18/thousand cf natural gas for commercial/industrial and $14.81/thousand cf natural gas for residential; $2.65/ gallon #2 light fuel oil; $3.00/gallon gasoline/diesel (assumes 1 average price per gallon); $0.00735/ gallon water residential supply and $0.005/gallon water commercial/industrial supply; $0.002166/gallon cost to residents and businesses for water treatment; $0.00018/gallon cost to utility associated with electricity to supply water; $0.000234/gallon cost associated with electricity used to WPCA to treat water.

[82] This employment opportunity calculation assumes 2 installers for ¼ day, or 0.5 man-days per freezer installation.

[83] Assumes air conditioner trade in for Energy Star unit as noted in UI and CL&P Program Savings Documentation for 2010 Program Year, pages 130-133: Room AC Retirement (Turn-In & Low Income) annual difference between old and new Energy Star unit, default values of 51 kWh for turned-in unit versus the Federal standard (4 years) and 26.3 kWh for the Federal standard verses the new CEE Tier I unit savings (12 years) for total savings of 77.3 kWh annual savings per unit.

[84] Upon recommendation of ICLEI, Bridgeport GHG Inventory conducted for calendar year 2007 used Egrid Subregion 1 – NPCC New England coefficient figures for 2004 as follows: CO2 908.9 lbs/MWH; N20 0.015 lbs/MWH; CH4 0.080 lbs/MWH and criteria air pollutants as follows: NOX 0.677 lbs/MWH; SOX 1.262 lbs/MWH; CO 1.216 lbs/MWH; VOC 0.136 lbs/MWH; PM10 0.982 lbs/MWH. Bridgeport inventory had input of 762,419,176 total kWh community-wide and reported 316,511 $MTCO_2e$ of electricity-related emissions for community-wide average of 0.000415141 $MTCO_2e$/kWh. Emissions savings calculated based upon this coefficient.

[85] Dollar savings are calculated using 2010 utility costs of $0.24/kWh electricity (includes all fees); $9.18/thousand cf natural gas for commercial/industrial and $14.81/thousand cf natural gas for residential; $2.65/ gallon #2 light fuel oil; $3.00/gallon gasoline/diesel (assumes 1 average price per gallon); $0.00735/ gallon water residential supply and $0.005/gallon water commercial/industrial supply; $0.002166/gallon cost to residents and businesses for water treatment; $0.00018/gallon cost to utility associated with electricity to supply water; $0.000234/gallon cost associated with electricity used to WPCA to treat water.

[86] Some sources report replacing a 10-year-old air conditioner can save $25 annually (see Center for Neighborhood Technology, 2008, Chicago Greenhouse Gas Emissions: An Inventory, Forecast, and Mitigation Analysis for Chicago and the Metropolitan Region; An assessment prepared for the City of Chicago http://www.chicagoclimateaction.org/filebin/pdf/FINALALL091708_1-118.pdf). This Bridgeport Energy Plan estimates the lower $19 annual utility savings based on calculations described above.

[87] Center for Neighborhood Technology, 2008, Chicago Greenhouse Gas Emissions: An Inventory, Forecast, and Mitigation Analysis for Chicago and the Metropolitan Region; An assessment prepared for the City of Chicago http://www.chicagoclimateaction.org/filebin/pdf/FINALALL091708_1-118.pdf).

[88] Lowe's, www.lowes.com, as cited in Center for Neighborhood Technology, 2008, Chicago Greenhouse Gas Emissions: An Inventory, Forecast, and Mitigation Analysis for Chicago and the Metropolitan Region; An assessment prepared for the City of Chicago http://www.chicagoclimateaction.org/filebin/pdf/FINALALL091708_1-118.pdf).

[89] Assumes energy savings based on Clothes Washer, Energy Star for Income Eligible, unknown fuels in UI and CL&P Program Savings Documentation for 2010 Program Year, pages 123-125: Clothes Washer (Retail Products, HES & Low Income) annual difference between old and new Energy Star (July 2009) for Early Retirement gross Annual Savings Water Heater and Dryer Fuel Type Unknown i.e. Retail Sales, which includes 17 kWh electricity, 0.12 ccf gas, 0.18 gallons of oil and 4,154 BTU's unknown fuels (other hot water fuel) as well as 0.22 ccf unknown fuels ccf gas for dryer. This Energy Report uses this single year figure for all annual savings figures, and does not include a separate early retirement savings. Energy savings related to water savings are not included in these figures, but are included in separate section of Bridgeport Energy Plan, which address water savings and related energy savings.

[90] Upon recommendation of ICLEI, Bridgeport GHG Inventory conducted for calendar year 2007 used Egrid Subregion 1 – NPCC New England coefficient figures for 2004 as follows: CO2 908.9 lbs/MWH; N20 0.015 lbs/MWH; CH4 0.080 lbs/MWH and criteria air pollutants as follows: NOX 0.677 lbs/MWH; SOX 1.262 lbs/MWH; CO 1.216 lbs/MWH; VOC 0.136 lbs/MWH; PM10 0.982 lbs/MWH. Bridgeport inventory had input of 762,419,176 total kWh community-wide and reported 316,511 $MTCO_2e$ of electricity-related emissions for community-wide average of 0.000415141 $MTCO_2e$/kWh. Electricity emissions savings are calculated based upon this coefficient. Bridgeport GHG Inventory for calendar year 2007 had input of 9,585 thousand gallons of light fuel oil community-wide and reported 100,588 $MTCO_2e$ of light fuel oil-related emissions community-wide for average of 9.367 $MTCO_2e$/thousand gallons of fuel oil. Oil-related emissions savings are calculated based upon this coefficient. Bridgeport GHG Inventory for calendar year 2007 had input of 3,998,557 thousand cubic feet of natural gas community-wide and reported 228,616 $MTCO_2e$ of natural gas-related emissions community-wide for average of 0.057175 $MTCO_2e$/thousand cf. Gas-related emissions savings are calculated based upon this coefficient.

[91] Dollar savings are calculated using 2010 utility costs of $0.24/kWh electricity (includes all fees); $9.18/thousand cf natural gas for commercial/industrial and $14.81/thousand cf natural gas for residential; $2.65/ gallon #2 light fuel oil; $3.00/gallon gasoline/diesel (assumes 1 average price per gallon); $0.00735/ gallon water residential supply and $0.005/gallon water commercial/industrial supply; $0.002166/gallon cost to residents and businesses for water treatment; $0.00018/gallon cost to utility associated with electricity to supply water; $0.000234/gallon cost associated with electricity used to WPCA to treat water.

[92] This employment opportunity calculation assumes 2 installers for ¼ day, or 0.5 man-days per clothes washer installation. This assumption discounts the fact that some clothes washers may be self-installed.

[93] Assumes energy savings based on Dishwasher, Energy Star unknown fuels in UI and CL&P Program Savings Documentation for 2010 Program Year, pages 126-127: Dishwasher (Retail Products, HES & Low Income) annual difference between old and CEE Tier 2 for Gross Annual Savings (New Units)

Fuel Type Unknown i.e. Retail Sales of 3 kWh electricity, 0.16 ccf natural gas, 0.36 gallons oil, and 5,391 BTU's other fossil fuel. This Energy Report uses this single year figure for all annual savings figures, and does not include a separate early retirement savings.

[94] Upon recommendation of ICLEI, Bridgeport GHG Inventory conducted for calendar year 2007 used Egrid Subregion 1 – NPCC New England coefficient figures for 2004 as follows: CO2 908.9 lbs/MWH; N20 0.015 lbs/MWH; CH4 0.080 lbs/MWH and criteria air pollutants as follows: NOX 0.677 lbs/MWH; SOX 1.262 lbs/MWH; CO 1.216 lbs/MWH; VOC 0.136 lbs/MWH; PM10 0.982 lbs/MWH. Bridgeport inventory had input of 762,419,176 total kWh community-wide and reported 316,511 $MTCO_2e$ of electricity-related emissions for community-wide average of 0.000415141 $MTCO_2e$/kWh. Electricity emissions savings are calculated based upon this coefficient. Bridgeport GHG Inventory for calendar year 2007 had input of 9,585 thousand gallons of light fuel oil community-wide and reported 100,588 $MTCO_2e$ of light fuel oil-related emissions community-wide for average of 9.367 $MTCO_2e$/thousand gallons of fuel oil. Oil-related emissions savings are calculated based upon this coefficient. Bridgeport GHG Inventory for calendar year 2007 had input of 3,998,557 thousand cubic feet of natural gas community-wide and reported 228,616 $MTCO_2e$ of natural gas-related emissions community-wide for average of 0.057175 $MTCO_2e$/thousand cf. Gas-related emissions savings are calculated based upon this coefficient.

[95] Dollar savings are calculated using 2010 utility costs of $0.24/kWh electricity (includes all fees); $9.18/thousand cf natural gas for commercial/industrial and $14.81/thousand cf natural gas for residential; $2.65/ gallon #2 light fuel oil; $3.00/gallon gasoline/diesel (assumes 1 average price per gallon); $0.00735/ gallon water residential supply and $0.005/gallon water commercial/industrial supply; $0.002166/gallon cost to residents and businesses for water treatment; $0.00018/gallon cost to utility associated with electricity to supply water; $0.000234/gallon cost associated with electricity used to WPCA to treat water.

[96] Hot water heating impact only. The impact on energy demand and emissions associated with water supply and treatment is addressed in a separate Water Resources section of this Bridgeport Energy Plan.

[97] Assumes installation of 1 showerhead per household with average change from 4 to 2.2 GPM water flow and reflects Bridgeport's residential heating oil split (including condominiums) of 4.76% electric, 48.42% gas, and 46.70% oil (from Bridgeport Tax Assessor data). Energy savings are derived from UI and CL&P Program Savings Documentation for 2010 Program Year, pages 161-162: Low Flow Showerheads, HES and Low Income; average 4 to 2.2 GPM savings of 577 kWh/year savings per showerhead for electric water heater, 3.08 MBTU/year of gas savings per showerhead for gas water heater, and 25.6 gallons/year of oil savings per showerhead for oil water heater.

[98] Upon recommendation of ICLEI, Bridgeport GHG Inventory conducted for calendar year 2007 used Egrid Subregion 1 – NPCC New England coefficient figures for 2004 as follows: CO2 908.9 lbs/MWH; N20 0.015 lbs/MWH; CH4 0.080 lbs/MWH and criteria air pollutants as follows: NOX 0.677 lbs/MWH; SOX 1.262 lbs/MWH; CO 1.216 lbs/MWH; VOC 0.136 lbs/MWH; PM10 0.982 lbs/MWH. Bridgeport inventory had input of 762,419,176 total kWh community-wide and reported 316,511 $MTCO_2e$ of electricity-related emissions for community-wide average of 0.000415141 $MTCO_2e$/kWh. Electricity emissions savings are calculated based upon this coefficient. Bridgeport GHG Inventory for calendar year 2007 had input of 9,585 thousand gallons of light fuel oil community-wide and reported 100,588 $MTCO_2e$ of light fuel oil-related emissions community-wide for average of 9.367 $MTCO_2e$/thousand gallons of fuel oil. Oil-related emissions savings are calculated based upon this coefficient. Bridgeport GHG Inventory for calendar year 2007 had input of 3,998,557 thousand cubic feet of natural gas community-wide and reported 228,616 $MTCO_2e$ of natural gas-related emissions community-wide for average of 0.057175 $MTCO_2e$/thousand cf. Gas-related emissions savings are calculated based upon this coefficient.

[99] Dollar savings are calculated using 2010 utility costs of $0.24/kWh electricity (includes all fees); $9.18/thousand cf natural gas for commercial/industrial and $14.81/thousand cf natural gas for residential; $2.65/ gallon #2 light fuel oil; $3.00/gallon gasoline/diesel (assumes 1 average price per gallon); $0.00735/ gallon water residential supply and $0.005/gallon water commercial/industrial supply; $0.002166/gallon cost to residents and businesses for water treatment; $0.00018/gallon cost to utility associated with electricity to supply water; $0.000234/gallon cost associated with electricity used to WPCA to treat water.

[100] This employment opportunity calculation assumes this measure would require 1 man-day per installation of 1 showerhead in 10 households, but also assumes 50% would be self installed, for net employment need of 0.5 man-days per 10 households.

[101] Hot water heating impact only. The impact on energy demand and emissions associated with water supply and treatment is addressed in a separate Water Resources section of this Bridgeport Energy Plan. Assumes installation of two faucet aerators per household.

[102] This employment opportunity calculation assumes installation of 2 faucet aerators per household with change from 2.2 to 1.5 GPM and reflects Bridgeport's residential heating oil split (including condominiums) of 4.76% electric, 48.42% gas, and 46.70% oil (from Bridgeport Tax Assessor data).

Energy savings are derived from UI and CL&P Program Savings Documentation for 2010 Program Year, pages 163-164: Faucet Aerator 2.2 to 1.5 GPM average savings of 17.26 kWh/year/faucet electricity savings, 0.09 MBTU/year/faucet gas savings, and 0.77 gallons/year/faucet oil savings.

[103] Upon recommendation of ICLEI, Bridgeport GHG Inventory conducted for calendar year 2007 used Egrid Subregion 1 – NPCC New England coefficient figures for 2004 as follows: CO2 908.9 lbs/MWH; N20 0.015 lbs/MWH; CH4 0.080 lbs/MWH and criteria air pollutants as follows: NOX 0.677 lbs/MWH; SOX 1.262 lbs/MWH; CO 1.216 lbs/MWH; VOC 0.136 lbs/MWH; PM10 0.982 lbs/MWH. Bridgeport inventory had input of 762,419,176 total kWh community-wide and reported 316,511 $MTCO_2e$ of electricity-related emissions for community-wide average of 0.000415141 $MTCO_2e$/kWh. Electricity emissions savings are calculated based upon this coefficient. Bridgeport GHG Inventory for calendar year 2007 had input of 9,585 thousand gallons of light fuel oil community-wide and reported 100,588 $MTCO_2e$ of light fuel oil-related emissions community-wide for average of 9.367 $MTCO_2e$/thousand gallons of fuel oil. Oil-related emissions savings are calculated based upon this coefficient. Bridgeport GHG Inventory for calendar year 2007 had input of 3,998,557 thousand cubic feet of natural gas community-wide and reported 228,616 $MTCO_2e$ of natural gas-related emissions community-wide for average of 0.057175 $MTCO_2e$/thousand cf. Gas-related emissions savings are calculated based upon this coefficient.

[104] Dollar savings are calculated using 2010 utility costs of $0.24/kWh electricity (includes all fees); $9.18/thousand cf natural gas for commercial/industrial and $14.81/thousand cf natural gas for residential; $2.65/ gallon #2 light fuel oil; $3.00/gallon gasoline/diesel (assumes 1 average price per gallon); $0.00735/ gallon water residential supply and $0.005/gallon water commercial/industrial supply; $0.002166/gallon cost to residents and businesses for water treatment; $0.00018/gallon cost to utility associated with electricity to supply water; $0.000234/gallon cost associated with electricity used to WPCA to treat water.

[105] Calculated from 2010 projection data in The Connecticut Light and Power Company, The United Illuminating Company, Yankee Gas Services Company, Connecticut Natural Gas Corporation and The Southern Connecticut Gas Company, Docket No. 09-10-10, Docket No. 08-10-02, October 1, 2009, 2010 Electric and Natural Gas Conservation and Load Management Plan, Page 142: SCG 2010 goal of 18,924 ccf annual savings / 311 units = 60.85 ccf/unit/year.

[106] Bridgeport GHG Inventory for calendar year 2007 had input of 3,998,557 thousand cubic feet of natural gas community-wide and reported 228,616 $MTCO_2e$ of natural gas-related emissions community-wide for average of 0.057175 $MTCO_2e$/thousand cf. Gas-related emissions savings are calculated based upon this coefficient.

[107] Dollar savings are calculated using 2010 utility costs of $0.24/kWh electricity (includes all fees); $9.18/thousand cf natural gas for commercial/industrial and $14.81/thousand cf natural gas for residential; $2.65/ gallon #2 light fuel oil; $3.00/gallon gasoline/diesel (assumes 1 average price per gallon); $0.00735/ gallon water residential supply and $0.005/gallon water commercial/industrial supply; $0.002166/gallon cost to residents and businesses for water treatment; $0.00018/gallon cost to utility associated with electricity to supply water; $0.000234/gallon cost associated with electricity used to WPCA to treat water.

[108] American Council for an Energy Efficient Economy, Consumer Guide to Home Energy Savings: Condensed Online Version, *Water Heating,* http://www.aceee.org/consumerguide/waterheating.htm

[109] This employment opportunity calculation assumes this measure would require 3 installers for 2 days per unit or 6 man-days/unit.

[110] This assumes 25% reduction in energy use per household from current level. Per household energy consumption in each of 47,543 households, as calculated from Bridgeport 2007 GHG Inventory is 6949.82763 kWh electricity, 35.71183981 thousand cubic feet of gas, and 0.097658961 thousand gallons of fuel oil.

[111] Emissions calculated from Bridgeport 2007 GHG inventory averages. Upon recommendation of ICLEI, Bridgeport GHG Inventory conducted for calendar year 2007 used Egrid Subregion 1 – NPCC New England coefficient figures for 2004 as follows: CO2 908.9 lbs/MWH; N20 0.015 lbs/MWH; CH4 0.080 lbs/MWH and criteria air pollutants as follows: NOX 0.677 lbs/MWH; SOX 1.262 lbs/MWH; CO 1.216 lbs/MWH; VOC 0.136 lbs/MWH; PM10 0.982 lbs/MWH. Bridgeport inventory had input of 762,419,176 total kWh community-wide and reported 316,511 $MTCO_2e$ of electricity-related emissions for community-wide average of 0.000415141 $MTCO_2e$/kWh. Electricity emissions savings are calculated based upon this coefficient. Bridgeport GHG Inventory for calendar year 2007 had input of 9,585 thousand gallons of light fuel oil community-wide and reported 100,588 $MTCO_2e$ of light fuel oil-related emissions community-wide for average of 9.367 $MTCO_2e$/thousand gallons of fuel oil. Oil-related emissions savings are calculated based upon this coefficient. Bridgeport GHG Inventory for calendar year 2007 had input of 3,998,557 thousand cubic feet of natural gas community-wide and reported 228,616 $MTCO_2e$ of natural gas-related emissions community-wide for average of 0.057175 $MTCO_2e$/thousand cf. Gas-related emissions savings are calculated based upon this coefficient.

[112] Dollar savings are calculated using 2010 utility costs of $0.24/kWh electricity (includes all fees); $9.18/thousand cf natural gas for commercial/industrial and $14.81/thousand cf natural gas for residential; $2.65/ gallon #2 light fuel oil; $3.00/gallon gasoline/diesel (assumes 1 average price per gallon); $0.00735/ gallon water residential supply and $0.005/gallon water commercial/industrial supply; $0.002166/gallon cost to residents and businesses for water treatment; $0.00018/gallon cost to utility associated with electricity to supply water; $0.000234/gallon cost associated with electricity used to WPCA to treat water.

[113] Greg Kats, Sustainable Building Task Force. "The Cost and Financial Benefits of Green Buildings." October 2003. www.ciwmb.ca.gov/GreenBuilding/Design/CostBenefit/Report.pdf.

[114] Greg Kats, Massachusetts Technology Collaborative, "Green Building Costs and Financial Benefits," 2003, http://www.google.com/search?sourceid=navclient&ie=UTF8&rlz=1T4HPND_en___US236&q=Green+Building+Costs+and+Financial+Benefits.

[115] Residential building sales for 5-year period represented 4.28% of the building stock per year (from Bridgeport Tax Assessor data). Over the 2007-2010 time period, this translates to sales equal to 98% of the residential building stock, although repeat sales of single buildings would likely reduce this number. Commercial building sales for 5-year period represented 5.61% of the building stock per year (Bridgeport Tax Assessor data). Over the 2007-2030 time period, this translates to sales of over 100% of commercial building stock, although repeat sales of single buildings would likely reduce this number.

[116] This employment opportunity calculation assumes this measure would require the following: a) new boiler and controls: 3 installers for 2 days = 6 man days; b) window replacement: 1 man day/4 windows and assume16 windows (because this is per household not per building) = 4 man-days; c) ceiling and wall insulation: 2 man-days insulation; d) lighting retrofits hardwire: 1 man-day; e)water fixtures: 1 man-day. Assume 14 man-days per complete job (1 household).

[117] Assumes 30% reduction in energy use per household from current level. Per household energy consumption in each of 47,543 households, as calculated from Bridgeport 2007 GHG Inventory is 6949.82763 kWh electricity, 35.71183981 thousand cubic feet of gas, and 0.097658961 thousand gallons of fuel oil.

[118] Emissions calculated from Bridgeport 2007 GHG inventory averages. Upon recommendation of ICLEI, Bridgeport GHG Inventory conducted for calendar year 2007 used Egrid Subregion 1 – NPCC New England coefficient figures for 2004 as follows: CO2 908.9 lbs/MWH; N20 0.015 lbs/MWH; CH4 0.080 lbs/MWH and criteria air pollutants as follows: NOX 0.677 lbs/MWH; SOX 1.262 lbs/MWH; CO 1.216 lbs/MWH; VOC 0.136 lbs/MWH; PM10 0.982 lbs/MWH. Bridgeport inventory had input of 762,419,176 total kWh community-wide and reported 316,511 $MTCO_2e$ of electricity-related emissions for community-wide average of 0.000415141 $MTCO_2e$/kWh. Electricity emissions savings are calculated based upon this coefficient. Bridgeport GHG Inventory for calendar year 2007 had input of 9,585 thousand gallons of light fuel oil community-wide and reported 100,588 $MTCO_2e$ of light fuel oil-related emissions community-wide for average of 9.367 $MTCO_2e$/thousand gallons of fuel oil. Oil-related emissions savings are calculated based upon this coefficient. Bridgeport GHG Inventory for calendar year had input of 3,998,557 thousand cubic feet of natural gas community-wide and reported 228,616 $MTCO_2e$ of natural gas-related emissions community-wide for average of 0.057175 $MTCO_2e$/thousand cf. Gas-related emissions savings are calculated based upon this coefficient.

[119] Rounding accounts for difference.

[120] Dollar savings are calculated using 2010 utility costs of $0.24/kWh electricity (includes all fees); $9.18/thousand cf natural gas for commercial/industrial and $14.81/thousand cf natural gas for residential; $2.65/ gallon #2 light fuel oil; $3.00/gallon gasoline/diesel (assumes 1 average price per gallon); $0.00735/ gallon water residential supply and $0.005/gallon water commercial/industrial supply; $0.002166/gallon cost to residents and businesses for water treatment; $0.00018/gallon cost to utility associated with electricity to supply water; $0.000234/gallon cost associated with electricity used to WPCA to treat water.

[121] Dollar savings are calculated using 2010 utility costs of $0.24/kWh electricity (includes all fees); $9.18/thousand cf natural gas for commercial/industrial and $14.81/thousand cf natural gas for residential; $2.65/ gallon #2 light fuel oil; $3.00/gallon gasoline/diesel (assumes 1 average price per gallon); $0.00735/ gallon water residential supply and $0.005/gallon water commercial/industrial supply; $0.002166/gallon cost to residents and businesses for water treatment; $0.00018/gallon cost to utility associated with electricity to supply water; $0.000234/gallon cost associated with electricity used to WPCA to treat water.

[122] Greg Kats, Sustainable Building Task Force. "The Cost and Financial Benefits of Green Buildings." October 2003. www.ciwmb.ca.gov/GreenBuilding/Design/CostBenefit/Report.pdf.

[123] Greg Kats, Massachusetts Technology Collaborative, "Green Building Costs and Financial Benefits," 2003, http://www.google.com/search?sourceid=navclient&ie=UTF8&rlz=1T4HPND_en___US236&q=Green+Building+Costs+and+Financial+Benefits.

[124] Electricity savings calculated from 2010 projection data for major renovations or new construction C and I - Energy Conscious BluePrint program - in The Connecticut Light and Power Company, The United Illuminating Company, Yankee Gas Services Company, Connecticut Natural Gas Corporation and The Southern Connecticut Gas Company, Docket No. 09-10-10, Docket No. 08-10-02, October 1, 2009, 2010 Electric and Natural Gas Conservation and Load Management Plan, pages 161-162: UI 2010 goal of 10,066,859 kWh / 175 projects = 57,524.91 kWh savings/project/year. Gas savings calculated from 2010 projection data for major renovations or new construction C and I – energy conscious BluePrint program - in The Connecticut Light and Power Company, The United Illuminating Company, Yankee Gas Services Company, Connecticut Natural Gas Corporation and The Southern Connecticut Gas Company, Docket No. 09-10-10, Docket No. 08-10-02, October 1, 2009, 2010 Electric and Natural Gas Conservation and Load Management Plan, page 165: 2010 SCG goal of 118,166 ccf / 48 projects = 2,461.79 ccf savings/project/year.

[125] Emissions calculated from Bridgeport 2007 GHG inventory averages. Upon recommendation of ICLEI, Bridgeport GHG Inventory conducted for calendar year 2007 used Egrid Subregion 1 – NPCC New England coefficient figures for 2004 as follows: CO2 908.9 lbs/MWH; N20 0.015 lbs/MWH; CH4 0.080 lbs/MWH and criteria air pollutants as follows: NOX 0.677 lbs/MWH; SOX 1.262 lbs/MWH; CO 1.216 lbs/MWH; VOC 0.136 lbs/MWH; PM10 0.982 lbs/MWH. Bridgeport inventory had input of 762,419,176 total kWh community-wide and reported 316,511 $MTCO_2e$ of electricity-related emissions for community-wide average of 0.000415141 $MTCO_2e$/kWh. Electricity emissions savings are calculated based upon this coefficient. Bridgeport GHG Inventory for calendar year 2007 had input of 3,998,557 thousand cubic feet of natural gas community-wide and reported 228,616 $MTCO_2e$ of natural gas-related emissions community-wide for average of 0.057175 $MTCO_2e$/thousand cf. Gas-related emissions savings are calculated based upon this coefficient.

[126] Dollar savings are calculated using 2010 utility costs of $0.24/kWh electricity (includes all fees); $9.18/thousand cf natural gas for commercial/industrial and $14.81/thousand cf natural gas for residential; $2.65/ gallon #2 light fuel oil; $3.00/gallon gasoline/diesel (assumes 1 average price per gallon); $0.00735/ gallon water residential supply and $0.005/gallon water commercial/industrial supply; $0.002166/gallon cost to residents and businesses for water treatment; $0.00018/gallon cost to utility associated with electricity to supply water; $0.000234/gallon cost associated with electricity used to WPCA to treat water.

[127] Dollar savings are calculated using 2010 utility costs of $0.24/kWh electricity (includes all fees); $9.18/thousand cf natural gas for commercial/industrial and $14.81/thousand cf natural gas for residential; $2.65/ gallon #2 light fuel oil; $3.00/gallon gasoline/diesel (assumes 1 average price per gallon); $0.00735/ gallon water residential supply and $0.005/gallon water commercial/industrial supply; $0.002166/gallon cost to residents and businesses for water treatment; $0.00018/gallon cost to utility associated with electricity to supply water; $0.000234/gallon cost associated with electricity used to WPCA to treat water.

[128] Greg Kats, Sustainable Building Task Force. "The Cost and Financial Benefits of Green Buildings." October 2003. www.ciwmb.ca.gov/GreenBuilding/Design/CostBenefit/Report.pdf.

[129] Greg Kats, Massachusetts Technology Collaborative, "Green Building Costs and Financial Benefits," 2003, http://www.google.com/search?sourceid=navclient&ie=UTF8&rlz=1T4HPND_en___US236&q=Green+Building+Costs+and+Financial+Benefits.

[130] This energy plan assumes three percent reduction is possible based upon the following research (reported in McPherson, Gregory and James R. Simpson, March/April 1995, Shade Trees as a Demand-Side Resource, Home Energy Magazine Online, http://www.homeenergy.org/archive/hem.dis.anl.gov/eehem/95/950307.html): from multi location simulations these authors determine that a single mature tree reduces annual air conditioning use by 2%-8%, that its evapotranspirational cooling reduces annual cooling energy by 2%-8%, and that its wind shielding reduces annual use of natural gas for space heating by 1%-5%. Chicago, in its greenhouse has inventory and energy plan, used a range of 1.5% to 3% of annual energy use on residential building stock less than or equal to 3 stories tall. See: Center for Neighborhood Technology, 2008, Chicago Greenhouse Gas Emissions: An Inventory, Forecast, and Mitigation Analysis for Chicago and the Metropolitan Region; An assessment prepared for the City of Chicago http://www.chicagoclimateaction.org/filebin/pdf/FINALALL091708_118-266.pdf. This was based on above research as well as the following: McPherson, E. Gregory; Nowak, David J.; Rowntree, Rowan A. eds. 1994. Chicago's urban forest ecosystem: results of the Chicago Urban Forest Climate Project. Gen. Tech. Rep. NE-186. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station: 201 p. http://www.nrs.fs.fed.us/pubs/gtr/gtr_ne186.pdf

[131] Percent Bridgeport residential stock, excluding condominiums, under 3 stories is 96% or 22,009 buildings (derived from City of Bridgeport Tax Assessor data). Energy Plan assumes 50% of residential buildings are already "fully-stocked." Additional tree inventory may be used to fine-tune this assumption.

[132] Assumes heating and cooling energy is 56% of total building energy (U.S. DOE, Home Energy tips, http://www.energy.gov/heatingcooling.htm). Energy consumption figures are per building, not household, and are based on Bridgeport 2007 GHG Inventory and 22,009 building number (derived from City of Bridgeport Tax Assessor data).

[133] Emissions calculated from Bridgeport 2007 GHG inventory averages. Upon recommendation of ICLEI, Bridgeport GHG Inventory conducted for calendar year 2007 used Egrid Subregion 1 – NPCC New England coefficient figures for 2004 as follows: CO2 908.9 lbs/MWH; N20 0.015 lbs/MWH; CH4 0.080 lbs/MWH and criteria air pollutants as follows: NOX 0.677 lbs/MWH; SOX 1.262 lbs/MWH; CO 1.216 lbs/MWH; VOC 0.136 lbs/MWH; PM10 0.982 lbs/MWH. Bridgeport inventory had input of 762,419,176 total kWh community-wide and reported 316,511 $MTCO_2e$ of electricity-related emissions for community-wide average of 0.000415141 $MTCO_2e$/kWh. Electricity emissions savings are calculated based upon this coefficient. Bridgeport GHG Inventory for calendar year 2007 had input of 9,585 thousand gallons of light fuel oil community-wide and reported 100,588 $MTCO_2e$ of light fuel oil-related emissions community-wide for average of 9.367 $MTCO_2e$/thousand gallons of fuel oil. Oil-related emissions savings are calculated based upon this coefficient. Bridgeport GHG Inventory for calendar year 2007 had input of 3,998,557 thousand cubic feet of natural gas community-wide and reported 228,616 $MTCO_2e$ of natural gas-related emissions community-wide for average of 0.057175 $MTCO_2e$/thousand cf. Gas-related emissions savings are calculated based upon this coefficient.

[134] Tree stocking potential developed based upon the following: average residential building footprint (excluding condominiums) equals 1,064 (derived from Bridgeport Tax Assessor data); average length of one side in average residential perimeter equals 33 feet; average length of two sides in average residential perimeter equals 65 feet. Optimal and realistic tree stocking potential is two sides per building. At 1 tree/30 feet, average tree stocking per residential building on 2 sides equals 2, and at 1 tree/20 feet, average tree stocking per residential building equals 3. Tree stocking calculations assume a 50/50 mix of 2 and 3 trees for each residential building.

[135] Dollar savings are calculated using 2010 utility costs of $0.24/kWh electricity (includes all fees); $9.18/thousand cf natural gas for commercial/industrial and $14.81/thousand cf natural gas for residential; $2.65/ gallon #2 light fuel oil; $3.00/gallon gasoline/diesel (assumes 1 average price per gallon); $0.00735/ gallon water residential supply and $0.005/gallon water commercial/industrial supply; $0.002166/gallon cost to residents and businesses for water treatment; $0.00018/gallon cost to utility associated with electricity to supply water; $0.000234/gallon cost associated with electricity used to WPCA to treat water.

[136] Assumes heating and cooling energy is 56% of total building energy (U.S. DOE, Home Energy tips, http://www.energy.gov/heatingcooling.htm). Energy consumption figures are per building, not household, and are based on Bridgeport 2007 GHG Inventory and 22,009 building number (derived from City of Bridgeport Tax Assessor data).

[137]Emissions calculated from Bridgeport 2007 GHG inventory averages. Upon recommendation of ICLEI, Bridgeport GHG Inventory conducted for calendar year 2007 used Egrid Subregion 1 – NPCC New England coefficient figures for 2004 as follows: CO2 908.9 lbs/MWH; N20 0.015 lbs/MWH; CH4 0.080 lbs/MWH and criteria air pollutants as follows: NOX 0.677 lbs/MWH; SOX 1.262 lbs/MWH; CO 1.216 lbs/MWH; VOC 0.136 lbs/MWH; PM10 0.982 lbs/MWH. Bridgeport inventory had input of 762,419,176 total kWh community-wide and reported 316,511 $MTCO_2e$ of electricity-related emissions for community-wide average of 0.000415141 $MTCO_2e$/kWh. Electricity emissions savings are calculated based upon this coefficient. Bridgeport GHG Inventory for calendar year 2007 had input of 9,585 thousand gallons of light fuel oil community-wide and reported 100,588 $MTCO_2e$ of light fuel oil-related emissions community-wide for average of 9.367 $MTCO_2e$/thousand gallons of fuel oil. Oil-related emissions savings are calculated based upon this coefficient. Bridgeport GHG Inventory for calendar year 2007 had input of 3,998,557 thousand cubic feet of natural gas community-wide and reported 228,616 $MTCO_2e$ of natural gas-related emissions community-wide for average of 0.057175 $MTCO_2e$/thousand cf. Gas-related emissions savings are calculated based upon this coefficient.

[138] Tree stocking potential developed based upon the following: average commercial building footprint equals 8,328 square feet (derived from Bridgeport Tax Assessor data); average length of one side in average commercial perimeter equals 91 feet; average length of two sides in average commercial perimeter equals 182 feet. Optimal and realistic tree stocking potential is two sides per building. At 1 tree/30 feet, average tree stocking per commercial building on 2 sides equals 6, and at 1 tree/20 feet, average tree stocking per commercial building equals 9. Tree stocking calculations assume a 50/50 mix of 6 and 9 trees for each commercial building. 1,943 buildings (or 79%) of commercial buildings are 3 stories tall or less. Energy savings calculated only for a portion of buildings equal to or less than 3 stories tall as recommended by Chicago Climate Plan (Center for Neighborhood Technology, 2008, Chicago Greenhouse Gas Emissions: An Inventory, Forecast, and Mitigation Analysis for Chicago and the Metropolitan Region; An

assessment prepared for the City of Chicago; http://www.chicagoclimateaction.org/filebin/pdf/FINALALL091708_118-266.pdf). Average tree stocking per C/I building at 1 tree per 30 feet on 2 sides equals 6. Average tree stocking per C/I building at 1 tree per 20 feet equals 9.

[139] Dollar savings are calculated using 2010 utility costs of $0.24/kWh electricity (includes all fees); $9.18/thousand cf natural gas for commercial/industrial and $14.81/thousand cf natural gas for residential; $2.65/ gallon #2 light fuel oil; $3.00/gallon gasoline/diesel (assumes 1 average price per gallon); $0.00735/ gallon water residential supply and $0.005/gallon water commercial/industrial supply; $0.002166/gallon cost to residents and businesses for water treatment; $0.00018/gallon cost to utility associated with electricity to supply water; $0.000234/gallon cost associated with electricity used to WPCA to treat water.

[140] 2007 Bridgeport commercial energy use was 432,003,521 kWh, 4,942 thousand gallons fuel oil, and 2,300,709 thousand cf natural gas and emissions were 179,342 $MTCO_2e$ electricity-related emissions, 52,856 $MTCO_2e$ oil-related emissions, and 131,542 $MTCO_2e$ gas-related emissions from 2007 GHG inventory. Total commercial living space of 41,693,810 derived from Bridgeport Tax Assessor data. Energy and emissions per square foot living space calculated from above. Total flat roof commercial building living space derived from Bridgeport Tax Assessor data equals 31,702,631 square feet. Energy consumption and emissions per square foot commercial living space determined from above. Assume heating and cooling energy and emissions equals 56% of total building energy (U.S. DOE, Home Energy tips, http://www.energy.gov/heatingcooling.htm). Assume low-end 20% savings in heating and cooling energy as a result of green roof installation (Center for Neighborhood Technology, 2008, Chicago Greenhouse Gas Emissions: An Inventory, Forecast, and Mitigation Analysis for Chicago and the Metropolitan Region; An assessment prepared for the City of Chicago; http://www.chicagoclimateaction.org/filebin/pdf/FINALALL091708_118-266.pdf). Potential savings per building based upon 1,531 flat roof commercial building number (Bridgeport Tax Assessor data).

[141] 460 buildings equal 30% of existing flat-roof commercial buildings. 2007 flat roof living area equals 76% of total commercial living area (flat plus non-flat) (Bridgeport Tax Assessor data). For Low Growth scenario, assume 14,916 total job increase is split as 500 industrial jobs and 14,416 commercial jobs. Square footage increase is calculated using 1.5 employee/1000 square feet for industrial jobs and 4 employees/1000 square feet for commercial jobs. Increased commercial square footage divided by Bridgeport average commercial/industrial living space of 17,046 square feet (Bridgeport Tax Assessor data) yields 231 new commercial buildings projected 2007-2030 under Low Growth scenario. Assume 76% of new buildings are flat-roof, so new flat roof C/I building number equals 175 for Low Growth scenario. Similar calculations yield additional C/I building increase of 195 total buildings under High Growth scenario, based on 27,500 total projected job increase and assumed split of 922 industrial/26,578 commercial jobs. Assume 76% of 195 additional commercial buildings under High Growth scenario are flat roof, yielding 148 additional new flat roof CI buildings. Green roofs proposed for 30% of new buildings under Low Growth and High Growth scenarios.

[142] Dollar savings are calculated using 2010 utility costs of $0.24/kWh electricity (includes all fees); $9.18/thousand cf natural gas for commercial/industrial and $14.81/thousand cf natural gas for residential; $2.65/ gallon #2 light fuel oil; $3.00/gallon gasoline/diesel (assumes 1 average price per gallon); $0.00735/ gallon water residential supply and $0.005/gallon water commercial/industrial supply; $0.002166/gallon cost to residents and businesses for water treatment; $0.00018/gallon cost to utility associated with electricity to supply water; $0.000234/gallon cost associated with electricity used to WPCA to treat water.

[143] Dollar savings are calculated using 2010 utility costs of $0.24/kWh electricity (includes all fees); $9.18/thousand cf natural gas for commercial/industrial and $14.81/thousand cf natural gas for residential; $2.65/ gallon #2 light fuel oil; $3.00/gallon gasoline/diesel (assumes 1 average price per gallon); $0.00735/ gallon water residential supply and $0.005/gallon water commercial/industrial supply; $0.002166/gallon cost to residents and businesses for water treatment; $0.00018/gallon cost to utility associated with electricity to supply water; $0.000234/gallon cost associated with electricity used to WPCA to treat water.

[144] Dollar savings are calculated using 2010 utility costs of $0.24/kWh electricity (includes all fees); $9.18/thousand cf natural gas for commercial/industrial and $14.81/thousand cf natural gas for residential; $2.65/ gallon #2 light fuel oil; $3.00/gallon gasoline/diesel (assumes 1 average price per gallon); $0.00735/ gallon water residential supply and $0.005/gallon water commercial/industrial supply; $0.002166/gallon cost to residents and businesses for water treatment; $0.00018/gallon cost to utility associated with electricity to supply water; $0.000234/gallon cost associated with electricity used to WPCA to treat water.

[145] Green Roofs for Healthy Cities, “About Green Roofs,” http://www.greenroofs.net/index.php?option=com_content&task=view&id=26&Itemid=40; and City of Chicago, Department of Planning and Development, “Extensive Green Roof Fact Sheet,” http://egov.cityofchicago.org/webportal/COCWebPortal/COC_ATTACH/Green_Roof_Fact_Sheet.pdf.

[146] Labor estimate is calculated based upon the following: labor for green roof construction equals $3 to $8 per square foot (School of Freshwater Sciences, Great Lakes Water Institute, University of Wisconsin, Milwaukee, Great Lakes WATER Institute Green Roof Project, Green Roof Installation, Green Roof Costs: An Example of the Typical Extensive Green Roof; http://www.glwi.uwm.edu/research/genomics/ecoli/greenroof/roofinstall.php). This Energy Plan assumes installation labor cost equals $5/square foot. Average footprint/roofprint of Bridgeport commercial flat roof property equals 9,695 square feet (Bridgeport Tax Assessor data), so installation cost equals $48,475. At $15/hr wage, installation requires 3,232man-hours, or 404 man-days per site.

[147] Urban Forest Protocol range is 16 kg/year (35 lbs/year) slow growing 8-15 cm DBH to 270 kg (60 lbs/year) larger growing at max height (California Climate Action Registry, Urban Forest Project Reporting Protocol Version 1.0 For Board Approval August 12, 2008; http://www.fs.fed.us/psw/programs/cufr/UrbanForestProtocol0812081ForBoardApproval.pdf). Midpoint of 16 kg per year and 270 kg per year is 71.5 kg per tree per year. This Bridgeport Energy Plan assumes the maximum potential, mid life, is at top of lowest quartile of range due to lack of longevity and stunting from urban stress and assumes 35 kg/tree/year carbon sequestration potential.

[148] This may be quantified at a future date. Michigan State University, among other institutions, is researching carbon sequestration potential of green roofs. See: http://www.hrt.msu.edu/greenroof/#Benefits%20of%20green%20, roofs and research update to USDA: http://www.reeis.usda.gov/web/crisprojectpages/180269.html

[149] Energy and emissions savings are calculated from Bridgeport 2007 GHG inventory averages. Upon recommendation of ICLEI, Bridgeport GHG Inventory conducted for calendar year 2007 used Egrid Subregion 1 – NPCC New England coefficient figures for 2004 as follows: CO2 908.9 lbs/MWH; N20 0.015 lbs/MWH; CH4 0.080 lbs/MWH and criteria air pollutants as follows: NOX 0.677 lbs/MWH; SOX 1.262 lbs/MWH; CO 1.216 lbs/MWH; VOC 0.136 lbs/MWH; PM10 0.982 lbs/MWH. Bridgeport inventory had input of 762,419,176 total kWh community-wide and reported 316,511 $MTCO_2e$ of electricity-related emissions for community-wide average of 0.000415141 $MTCO_2e$/kWh. Electricity emissions savings are calculated based upon this coefficient. Bridgeport GHG Inventory for calendar year 2007 had input of 9,585 thousand gallons of light fuel oil community-wide and reported 100,588 $MTCO_2e$ of light fuel oil-related emissions community-wide for average of 9.367 $MTCO_2e$/thousand gallons of fuel oil. Oil-related emissions savings are calculated based upon this coefficient. Bridgeport GHG Inventory for calendar year 2007 had input of 3,998,557 thousand cubic feet of natural gas community-wide and reported 228,616 $MTCO_2e$ of natural gas-related emissions community-wide for average of 0.057175 $MTCO_2e$/thousand cf. Gas-related emissions savings are calculated based upon this coefficient. This Bridgeport Energy Plan assumes action 1) changing heating and cooling by 3 degrees creates 9% savings in heating and cooling energy (Center for Neighborhood Technology, 2008, Chicago Greenhouse Gas Emissions: An Inventory, Forecast, and Mitigation Analysis for Chicago and the Metropolitan Region; An assessment prepared for the City of Chicago, http://www.chicagoclimateaction.org/filebin/pdf/FINALALL091708_1-118.pdf) and calculates this reduction based on assumption that heating and cooling represent 56% of household energy consumption (U.S. DOE, Home Energy tips, http://www.energy.gov/heatingcooling.htm). This Bridgeport Energy Plan assumes action 2) changing filters on air conditioners results in 10% reduction in cooling emissions based on City of Chicago greenhouse gas inventory (Center for Neighborhood Technology, 2008, Chicago Greenhouse Gas Emissions: An Inventory, Forecast, and Mitigation Analysis for Chicago and the Metropolitan Region; An assessment prepared for the City of Chicago, http://www.chicagoclimateaction.org/filebin/pdf/FINALALL091708_1-118.pdf). Assumes heating and cooling electricity is 56% of total electricity use and emissions (U.S. DOE, Home Energy tips, http://www.energy.gov/heatingcooling.htm). Related to action 3) turn off three sixty-watt light bulbs for 2 hours a day, this Bridgeport Energy Plan assumes 131.4 kWh savings total per year for this action per household and determines emissions based on Bridgeport average from Bridgeport GHG Inventory average of 0.000415141 $MTCO_2e$ per kWh. For action 4) savings from turning off appliances that contribute to phantom load, this Bridgeport Energy Plan assumes phantom load accounts for 4% of total household electricity use and electricity related emissions (Center for Neighborhood Technology, 2008, Chicago Greenhouse Gas Emissions: An Inventory, Forecast, and Mitigation Analysis for Chicago and the Metropolitan Region; An assessment prepared for the City of Chicago http://www.chicagoclimateaction.org/filebin/pdf/FINALALL091708_1-118.pdf).

[150] Dollar savings are calculated using 2010 utility costs of $0.24/kWh electricity (includes all fees); $9.18/thousand cf natural gas for commercial/industrial and $14.81/thousand cf natural gas for residential; $2.65/ gallon #2 light fuel oil; $3.00/gallon gasoline/diesel (assumes 1 average price per gallon); $0.00735/ gallon water residential supply and $0.005/gallon water commercial/industrial supply; $0.002166/gallon cost to residents and businesses for water treatment; $0.00018/gallon cost to utility associated with electricity to supply water; $0.000234/gallon cost associated with electricity used to WPCA to treat water.

[151] Dollar savings are calculated using 2010 utility costs of $0.24/kWh electricity (includes all fees); $9.18/thousand cf natural gas for commercial/industrial and $14.81/thousand cf natural gas for residential; $2.65/ gallon #2 light fuel oil; $3.00/gallon gasoline/diesel (assumes 1 average price per gallon); $0.00735/ gallon water residential supply and $0.005/gallon water commercial/industrial supply; $0.002166/gallon cost to residents and businesses for water treatment; $0.00018/gallon cost to utility associated with electricity to supply water; $0.000234/gallon cost associated with electricity used to WPCA to treat water.

[152] Dollar savings are calculated using 2010 utility costs of $0.24/kWh electricity (includes all fees); $9.18/thousand cf natural gas for commercial/industrial and $14.81/thousand cf natural gas for residential; $2.65/ gallon #2 light fuel oil; $3.00/gallon gasoline/diesel (assumes 1 average price per gallon); $0.00735/ gallon water residential supply and $0.005/gallon water commercial/industrial supply; $0.002166/gallon cost to residents and businesses for water treatment; $0.00018/gallon cost to utility associated with electricity to supply water; $0.000234/gallon cost associated with electricity used to WPCA to treat water.

[153] Energy and emissions savings are calculated from Bridgeport 2007 GHG inventory averages. Upon recommendation of ICLEI, Bridgeport GHG Inventory conducted for calendar year 2007 used Egrid Subregion 1 – NPCC New England coefficient figures for 2004 as follows: CO2 908.9 lbs/MWH; N20 0.015 lbs/MWH; CH4 0.080 lbs/MWH and criteria air pollutants as follows: NOX 0.677 lbs/MWH; SOX 1.262 lbs/MWH; CO 1.216 lbs/MWH; VOC 0.136 lbs/MWH; PM10 0.982 lbs/MWH. Bridgeport inventory had input of 762,419,176 total kWh community-wide and reported 316,511 $MTCO_2e$ of electricity-related emissions for community-wide average of 0.000415141 $MTCO_2e$/kWh. Electricity emissions savings are calculated based upon this coefficient. Bridgeport GHG Inventory for calendar year 2007 had input of 9,585 thousand gallons of light fuel oil community-wide and reported 100,588 $MTCO_2e$ of light fuel oil-related emissions community-wide for average of 9.367 $MTCO_2e$/thousand gallons of fuel oil. Oil-related emissions savings are calculated based upon this coefficient. Bridgeport GHG Inventory for calendar year 2007 had input of 3,998,557 thousand cubic feet of natural gas community-wide and reported 228,616 $MTCO_2e$ of natural gas-related emissions community-wide for average of 0.057175 $MTCO_2e$/thousand cf. Gas-related emissions savings are calculated based upon this coefficient. This Bridgeport Energy Plan assumes action 1) changing heating and cooling by 3 degrees creates 9% savings in heating and cooling energy (Center for Neighborhood Technology, 2008, Chicago Greenhouse Gas Emissions: An Inventory, Forecast, and Mitigation Analysis for Chicago and the Metropolitan Region; An assessment prepared for the City of Chicago,http://www.chicagoclimateaction.org/filebin/pdf/FINALALL091708_1-118.pdf) and calculates this reduction based on assumption that heating and cooling represent 56% of household energy consumption (U.S. DOE, Home Energy tips, http://www.energy.gov/heatingcooling.htm). This Bridgeport Energy Plan assumes action 2) changing filters on air conditioners results in 10% reduction in cooling emissions based on City of Chicago greenhouse gas inventory (Center for Neighborhood Technology, 2008, Chicago Greenhouse Gas Emissions: An Inventory, Forecast, and Mitigation Analysis for Chicago and the Metropolitan Region; An assessment prepared for the City of Chicago, http://www.chicagoclimateaction.org/filebin/pdf/FINALALL091708_1-118.pdf). Assumes heating and cooling electricity is 56% of total electricity use and emissions (U.S. DOE, Home Energy tips, http://www.energy.gov/heatingcooling.htm). Related to action 3) turn off three sixty-watt light bulbs for 2 hours a day, this Bridgeport Energy Plan assumes 131.4 kWh savings total per year for this action per household and determines emissions based on Bridgeport average from Bridgeport GHG Inventory average of 0.000415141 $MTCO_2e$ per kWh.

[154] Dollar savings are calculated using 2010 utility costs of $0.24/kWh electricity (includes all fees); $9.18/thousand cf natural gas for commercial/industrial and $14.81/thousand cf natural gas for residential; $2.65/ gallon #2 light fuel oil; $3.00/gallon gasoline/diesel (assumes 1 average price per gallon); $0.00735/ gallon water residential supply and $0.005/gallon water commercial/industrial supply; $0.002166/gallon cost to residents and businesses for water treatment; $0.00018/gallon cost to utility associated with electricity to supply water; $0.000234/gallon cost associated with electricity used to WPCA to treat water.

[155] Dollar savings are calculated using 2010 utility costs of $0.24/kWh electricity (includes all fees); $9.18/thousand cf natural gas for commercial/industrial and $14.81/thousand cf natural gas for residential; $2.65/ gallon #2 light fuel oil; $3.00/gallon gasoline/diesel (assumes 1 average price per gallon); $0.00735/ gallon water residential supply and $0.005/gallon water commercial/industrial supply; $0.002166/gallon cost to residents and businesses for water treatment; $0.00018/gallon cost to utility associated with electricity to supply water; $0.000234/gallon cost associated with electricity used to WPCA to treat water.

[156] Dollar savings are calculated using 2010 utility costs of $0.24/kWh electricity (includes all fees); $9.18/thousand cf natural gas for commercial/industrial and $14.81/thousand cf natural gas for residential; $2.65/ gallon #2 light fuel oil; $3.00/gallon gasoline/diesel (assumes 1 average price per gallon); $0.00735/ gallon water residential supply and $0.005/gallon water commercial/industrial supply; $0.002166/gallon cost to residents and businesses for water treatment; $0.00018/gallon cost to utility associated with electricity to supply water; $0.000234/gallon cost associated with electricity used to WPCA to treat water.

[157] Energy and emissions savings are calculated from Bridgeport 2007 GHG inventory averages. Upon recommendation of ICLEI, Bridgeport GHG Inventory conducted for calendar year 2007 used Egrid Subregion 1 – NPCC New England coefficient figures for 2004 as follows: CO2 908.9 lbs/MWH; N20 0.015 lbs/MWH; CH4 0.080 lbs/MWH and criteria air pollutants as follows: NOX 0.677 lbs/MWH; SOX 1.262 lbs/MWH; CO 1.216 lbs/MWH; VOC 0.136 lbs/MWH; PM10 0.982 lbs/MWH. Bridgeport inventory had input of 762,419,176 total kWh community-wide and reported 316,511 $MTCO_2e$ of electricity-related emissions for community-wide average of 0.000415141 $MTCO_2e$/kWh. Electricity emissions savings are calculated based upon this coefficient. Bridgeport GHG Inventory for calendar year 2007 had input of 9,585 thousand gallons of light fuel oil community-wide and reported 100,588 $MTCO_2e$ of light fuel oil-related emissions community-wide for average of 9.367 $MTCO_2e$/thousand gallons of fuel oil. Oil-related emissions savings are

calculated based upon this coefficient. Bridgeport GHG Inventory for calendar year 2007 had input of 3,998,557 thousand cubic feet of natural gas community-wide and reported 228,616 $MTCO_2e$ of natural gas-related emissions community-wide for average of 0.057175 $MTCO_2e$/thousand cf. Gas-related emissions savings are calculated based upon this coefficient. This Bridgeport Energy Plan assumes action 1) changing heating and cooling by 3 degrees creates 9% savings in heating and cooling energy (Center for Neighborhood Technology, 2008, Chicago Greenhouse Gas Emissions: An Inventory, Forecast, and Mitigation Analysis for Chicago and the Metropolitan Region; An assessment prepared for the City of Chicago , http://www.chicagoclimateaction.org/filebin/pdf/FINALALL091708_1-118.pdf) and calculates this reduction based on assumption that heating and cooling represent 56% of commercial building energy consumption (U.S. DOE, Home Energy tips, http://www.energy.gov/heatingcooling.htm). This Bridgeport Energy Plan assumes action 2) installing a programmable thermostat achieves 15% savings on heating and cooling energy based on City of Chicago greenhouse gas inventory (Center for Neighborhood Technology, 2008, Chicago Greenhouse Gas Emissions: An Inventory, Forecast, and Mitigation Analysis for Chicago and the Metropolitan Region; An assessment prepared for the City of Chicago,http://www.chicagoclimateaction.org/filebin/pdf/FINALALL091708_1-118.pdf).

[158] Dollar savings are calculated using 2010 utility costs of $0.24/kWh electricity (includes all fees); $9.18/thousand cf natural gas for commercial/industrial and $14.81/thousand cf natural gas for residential; $2.65/ gallon #2 light fuel oil; $3.00/gallon gasoline/diesel (assumes 1 average price per gallon); $0.00735/ gallon water residential supply and $0.005/gallon water commercial/industrial supply; $0.002166/gallon cost to residents and businesses for water treatment; $0.00018/gallon cost to utility associated with electricity to supply water; $0.000234/gallon cost associated with electricity used to WPCA to treat water.

[159] Dollar savings are calculated using 2010 utility costs of $0.24/kWh electricity (includes all fees); $9.18/thousand cf natural gas for commercial/industrial and $14.81/thousand cf natural gas for residential; $2.65/ gallon #2 light fuel oil; $3.00/gallon gasoline/diesel (assumes 1 average price per gallon); $0.00735/ gallon water residential supply and $0.005/gallon water commercial/industrial supply; $0.002166/gallon cost to residents and businesses for water treatment; $0.00018/gallon cost to utility associated with electricity to supply water; $0.000234/gallon cost associated with electricity used to WPCA to treat water.

[160] Dollar savings are calculated using 2010 utility costs of $0.24/kWh electricity (includes all fees); $9.18/thousand cf natural gas for commercial/industrial and $14.81/thousand cf natural gas for residential; $2.65/ gallon #2 light fuel oil; $3.00/gallon gasoline/diesel (assumes 1 average price per gallon); $0.00735/ gallon water residential supply and $0.005/gallon water commercial/industrial supply; $0.002166/gallon cost to residents and businesses for water treatment; $0.00018/gallon cost to utility associated with electricity to supply water; $0.000234/gallon cost associated with electricity used to WPCA to treat water.

[161] Air and Water, Inc., Honeywell Products, http://air-n- water.stores.yahoo.net/newhonther.html.

[162] The Electric Distribution Companies Integrated Resource Plan for Connecticut. Prepared by the Brattel Group for EDC's. http://www.ctenergy.org/pdf/2010IRP.pdf

[163] The Electric Distribution Companies Integrated Resource Plan for Connecticut. Prepared by the Brattel Group for EDC's. http://www.ctenergy.org/pdf/2010IRP.pdf

[164] 2010 Comprehensive Plan For the Procurement of Energy Resources. Prepared by the Energy Management Advisory Board, April 27, 2010; http://ctenergy.org/pdf/2010FullPlan.pdf

[165] kWh savings calculated based on 1,200 kWh/year per1 KW installed solar versus 8,760 kWh/year for 1 KW installed standard grid delivery (UI Company).

[166] Upon recommendation of ICLEI, Bridgeport GHG Inventory conducted for calendar year 2007 used Egrid Subregion 1 – NPCC New England coefficient figures for 2004 as follows: CO2 908.9 lbs/MWH; N20 0.015 lbs/MWH; CH4 0.080 lbs/MWH and criteria air pollutants as follows: NOX 0.677 lbs/MWH; SOX 1.262 lbs/MWH; CO 1.216 lbs/MWH; VOC 0.136 lbs/MWH; PM10 0.982 lbs/MWH. Electricity emissions calculated from Bridgeport GHG Inventory, which had input of 762,419,176 total kWh community-wide and reported 316,511 MTCO2e of electricity-related emissions community-wide for average of 0.000415141 MTCO2e/kWh.

[167] Dollar savings are calculated using 2010 utility costs of $0.24/kWh electricity (includes all fees); $9.18/thousand cf natural gas for commercial/industrial and $14.81/thousand cf natural gas for residential; $2.65/ gallon #2 light fuel oil; $3.00/gallon gasoline/diesel (assumes 1 average price per gallon); $0.00735/ gallon water residential supply and $0.005/gallon water commercial/industrial supply; $0.002166/gallon cost to residents

and businesses for water treatment; $0.00018/gallon cost to utility associated with electricity to supply water; $0.000234/gallon cost associated with electricity used to WPCA to treat water.

[168] California Electricity Analysis Office, "Comparative Cost Of California Central Station, Electricity Generation Technologies" Energy Policy Report Proceeding, Docket 02-IEP-01, Publication No. 100-03-001SD, February 2003; cited in Center for Neighborhood Technology, 2008, Chicago Greenhouse Gas Emissions: An Inventory, Forecast, and Mitigation Analysis for Chicago and the Metropolitan Region; An assessment prepared for the City of Chicago; http://www.chicagoclimateaction.org/filebin/pdf/FINALALL091708_1-118.pdf.

[169] Connecticut Energy Advisory Board (CEAB) Technical Paper: Renewable Energy; http://www.ctenergy.org/pdf/2010CEABPPPart4b2.pdf. Cited in this paper, and referenced here, is information from Lawrence Berkeley National Laboratory, *Tracking the Sun II* (LBNL report), October 2009.

[170] Assumes generation of 25% nameplate capacity, or 25% of 8,760kwh/yr per KW installed (Connecticut Energy Advisory Board, 2010 Comprehensive Plan for the Procurement of Energy Resources, http://www.ctenergy.org/pdf/2010CEABPPParts1-3.pdf).

[171] This is same generation size as windmill constructed at Phoenix Press in New Haven in 2010.

[172] Dollar savings are calculated using 2010 utility costs of $0.24/kWh electricity (includes all fees); $9.18/thousand cf natural gas for commercial/industrial and $14.81/thousand cf natural gas for residential; $2.65/ gallon #2 light fuel oil; $3.00/gallon gasoline/diesel (assumes 1 average price per gallon); $0.00735/ gallon water residential supply and $0.005/gallon water commercial/industrial supply; $0.002166/gallon cost to residents and businesses for water treatment; $0.00018/gallon cost to utility associated with electricity to supply water; $0.000234/gallon cost associated with electricity used to WPCA to treat water.

[173] Connecticut wind potential is estimated by Truewind for NREL in Estimates of Windy Land Area and Wind Energy Potential by State for Areas >= 30% Capacity Factor at 80m; February 4, 2010.

[174] CEAB Technical Paper: Renewable Energy;http://www.ctenergy.org/pdf/2010CEABPPPart4b2.pdf

[175] Combined "green" electricity purchase in 2007 equaled 8,900,000 kWh, resulting from Public Facilities purchase of 4,200,000 kWh and Board of Education purchase of 4,700,000 kWh (Bridgeport Public Facilities).

[176] This does not include any adjustment for increase or decrease in consumption as a result of closing of facilities or construction of new facilities.

[177] Upon recommendation of ICLEI, Bridgeport GHG Inventory conducted for calendar year 2007 used Egrid Subregion 1 – NPCC New England coefficient figures for 2004 as follows: CO2 908.9 lbs/MWH; N20 0.015 lbs/MWH; CH4 0.080 lbs/MWH and criteria air pollutants as follows: NOX 0.677 lbs/MWH; SOX 1.262 lbs/MWH; CO 1.216 lbs/MWH; VOC 0.136 lbs/MWH; PM10 0.982 lbs/MWH. Electricity emissions calculated from Bridgeport GHG Inventory, which had input of 762,419,176 total kWh community-wide and reported 316,511 MTCO2e of electricity-related emissions community-wide for average of 0.000415141 MTCO2e/kWh.

[178] Dollar savings are calculated using 2010 utility costs of $0.24/kWh electricity (includes all fees); $9.18/thousand cf natural gas for commercial/industrial and $14.81/thousand cf natural gas for residential; $2.65/ gallon #2 light fuel oil; $3.00/gallon gasoline/diesel (assumes 1 average price per gallon); $0.00735/ gallon water residential supply and $0.005/gallon water commercial/industrial supply; $0.002166/gallon cost to residents and businesses for water treatment; $0.00018/gallon cost to utility associated with electricity to supply water; $0.000234/gallon cost associated with electricity used to WPCA to treat water.

[179] Connecticut Clean Energy Fund notes that Bridgeport has 183 CTCEO Customers, which equals 0.4% of Bridgeport households (Connecticut Clean Energy Fund website (May 2010 search) http://www.ctcleanenergy.com/default.aspx?tabid=170).

[180] The 47,543 household number for 2007 is derived from CT State Data Center: Rodriguez, Orlando, 2007; Bridgeport, CT Population Projection from 2010 to 2030 by Age, Ethnicity and Sex Distributions, Connecticut State Data Center, University of Connecticut, Storrs, Connecticut, and assuming linear growth between 2005 and 2010. Electricity consumption per household calculated from Bridgeport 2007 GHG inventory, which had residential electricity consumption of 330,415,655 kWh.

[181] Upon recommendation of ICLEI, Bridgeport GHG Inventory conducted for calendar year 2007 used Egrid Subregion 1 – NPCC New England coefficient figures for 2004 as follows: CO2 908.9 lbs/MWH; N20 0.015 lbs/MWH; CH4 0.080 lbs/MWH and criteria air pollutants as follows: NOX 0.677 lbs/MWH; SOX 1.262 lbs/MWH; CO 1.216 lbs/MWH; VOC 0.136 lbs/MWH; PM10 0.982 lbs/MWH. Electricity emissions calculated from Bridgeport GHG Inventory, which had input of 762,419,176 total kWh community-wide and reported 316,511 MTCO2e of electricity-related emissions community-wide for average of 0.000415141 MTCO2e/kWh.

[182] Rounding accounts for difference in figures.

[183] Initial conceptual design study indicates that Bridgeport can offset up to 1 MW electricity or 1,750 gallons of gasoline equivalents per day depending upon exact retrofit measures taken and system installed (Conceptual Design of Renewable Energy Recovery Systems from Sewage Sludge and Other Waste Solids; Fuss and O'Neill; O'Brien & Gere, September 1, 2009). Energy savings and emissions used in this Energy Plan assume a 50% share of each of these two measures.

[184] Upon recommendation of ICLEI, Bridgeport GHG Inventory conducted for calendar year 2007 used Egrid Subregion 1 – NPCC New England coefficient figures for 2004 as follows: CO2 908.9 lbs/MWH; N20 0.015 lbs/MWH; CH4 0.080 lbs/MWH and criteria air pollutants as follows: NOX 0.677 lbs/MWH; SOX 1.262 lbs/MWH; CO 1.216 lbs/MWH; VOC 0.136 lbs/MWH; PM10 0.982 lbs/MWH. Electricity emissions are calculated from Bridgeport GHG Inventory, which had input of 762,419,176 total kWh community-wide and reported 316,511 MTCO2e of electricity-related emissions community-wide for average of 0.000415141 MTCO2e/kWh. Gasoline equivalent emissions are calculated from Bridgeport 2007 GHG Inventory, which had gasoline input of 27,018 thousand gallons (U.S) and diesel input of 5,301 thousand gallons for total input of 32,319 thousand gallons. This Bridgeport Energy Plan assumes a single emissions average for gasoline and diesel combined. Based on reported emissions of 313,960 MTCO2e for citywide roadway transportation, average roadway emissions equal 0.009714409 MT/gallon of "gasoline". Bridgeport 2007 GHG inventory had input of 475,513,500 gasoline-powered vehicle miles traveled (VMT) and 29,061,450 diesel-powered VMT for total input of 504,574,950 VMT. Average emissions based on Bridgeport citywide roadway VMT for gasoline and diesel VMT combined, and single fuel consumption figure for gasoline and diesel combined equals 0.000622227 MT per vehicle mile travelled.

[185] Dollar savings are calculated using 2010 utility costs of $0.24/kWh electricity (includes all fees); $9.18/thousand cf natural gas for commercial/industrial and $14.81/thousand cf natural gas for residential; $2.65/ gallon #2 light fuel oil; $3.00/gallon gasoline/diesel (assumes 1 average price per gallon); $0.00735/ gallon water residential supply and $0.005/gallon water commercial/industrial supply; $0.002166/gallon cost to residents and businesses for water treatment; $0.00018/gallon cost to utility associated with electricity to supply water; $0.000234/gallon cost associated with electricity used to WPCA to treat water.

[186] Conceptual Design of Renewable Energy Recovery Systems from Sewage Sludge and Other Waste Solids; Fuss and O'Neill; O'Brien & Gere, September 1, 2009

[187] Connecticut Energy Advisory Board, 2010 Comprehensive Plan for the Procurement of Energy Resources; April 27, 2010; http://ctenergy.org/pdf/2010FullPlan.pdf and The Electric Distribution Companies Integrated Resource Plan for Connecticut; Prepared by the Brattel Group for the Electric Distribution Companies; http://www.ctenergy.org/pdf/2010IRP.pdf

[188] The Electric Distribution Companies Integrated Resource Plan for Connecticut; Prepared by the Brattel Group for the Electric Distribution Companies; http://www.ctenergy.org/pdf/2010IRP.pdf

[189] Connecticut Energy Advisory Board, 2010 Comprehensive Plan for the Procurement of Energy Resources; April 27, 2010; http://ctenergy.org/pdf/2010FullPlan.pdf

[190] 2010 Comprehensive Plan For the Procurement of Energy Resources, Prepared by the Energy Advisory Board, April 27, 2010 http://ctenergy.org/pdf/2010FullPlan.pdf

[191] 2010 Comprehensive Plan For the Procurement of Energy Resources, Prepared by the Energy Advisory Board, April 27, 2010 http://ctenergy.org/pdf/2010FullPlan.pdf

[192] Total residential buildings in Bridgeport equal 22,866 (Bridgeport Tax Assessor data). Average electricity use and electricity-related emissions per building calculated from Bridgeport 2007 GHG Inventory data which had input of 330,415,655 kWh for residential sector electricity use and related emissions of 137,169 MTCO2e, which yield per building electricity consumption average of 14,450 kWh/year and electricity-related emissions equal to

6.0 MTCO2e. This Energy Plan assumes a 4KW solar pv system supplies 4,800 kWh electricity (derived from personal conversation with Sunlight Solar Energy, which indicates an average sized system of 5KW installed (for average site use of 1,000 kWh/month, or 12,000 kWh/year) delivers annual electricity equal to 5,800 to 6,000 kWh per year and a 5KW system installed averages 28 to 30 panels and requires 450 to 500 square feet installation space.)

[193] This Energy Plan assumes an average 4 KW residential system supplies 4,800 kWh per year and requires 100 square feet per KW installed, or 400 square feet roof space (based on numbers from Sunlight Solar Energy which indicate an average sized system of 5KW installed (for average site use of 1,000 kWh/month, or 12,000 kWh/year) delivers annual electricity equal to 5,800 to 6,000 kWh and that a 5KW system installed averages 28 to 30 panels and requires roof space of 450 to 500 square feet for installation). Bridgeport has 934 residential flat roof buildings, with total footprint (roof print) of 1,135,466 square feet (Bridgeport Tax Assessor data). Average footprint per building equals 1,216 square feet. This Energy Plan assumes loss of 50% roof space in calculating potential square footage available for solar installation, leaving 608 square feet potential per building for solar installation.

[194] Upon recommendation of ICLEI, Bridgeport GHG Inventory conducted for calendar year 2007 used Egrid Subregion 1 – NPCC New England coefficient figures for 2004 as follows: CO2 908.9 lbs/MWH; N20 0.015 lbs/MWH; CH4 0.080 lbs/MWH and criteria air pollutants as follows: NOX 0.677 lbs/MWH; SOX 1.262 lbs/MWH; CO 1.216 lbs/MWH; VOC 0.136 lbs/MWH; PM10 0.982 lbs/MWH. Electricity emissions are calculated from Bridgeport GHG Inventory, which had input of 762,419,176 total kWh community-wide and reported 316,511 MTCO2e of electricity-related emissions community-wide for average of 0.000415141 MTCO2e/kWh.

[195] Bridgeport Tax Assessor data for building number and square foot data.

[196] Dollar savings are calculated using 2010 utility costs of $0.24/kWh electricity (includes all fees); $9.18/thousand cf natural gas for commercial/industrial and $14.81/thousand cf natural gas for residential; $2.65/ gallon #2 light fuel oil; $3.00/gallon gasoline/diesel (assumes 1 average price per gallon); $0.00735/ gallon water residential supply and $0.005/gallon water commercial/industrial supply; $0.002166/gallon cost to residents and businesses for water treatment; $0.00018/gallon cost to utility associated with electricity to supply water; $0.000234/gallon cost associated with electricity used to WPCA to treat water.

[197] The Connecticut Energy Advisory Board reports that solar module prices are expected to drop as much as 30 percent in the next year or two, which would reduce installed costs about 15 percent from the current average installed cost of $7.50/watt for all systems. (Smaller systems cost more than this average per watt; larger systems cost less per watt.) The CEAB also notes that industry goals reported by SolarBuzz are a drop from $4+/watt to $1.5 to $2/watt by 2020 for module costs. Installed costs declined from $7.8/watt in 2007 to $7.5/watt in 2008. As a result of current and projected solar economics, CEAB currently recommends a delay in implementing significant solar installation as a means of meeting Connecticut's electricity supply. (CEAB Technical Paper: Renewable Energy; http://www.ctenergy.org/pdf/2010CEABPPPart4b2.pdf. Cited in this paper, and referenced here, is information from Lawrence Berkeley National Laboratory, Tracking the Sun II (LBNL report), October 2009.)

[198] Employment calculation assumes installation requirements are as follows: 13 man-days per residential site for installation of a 4KW system. This figure does not include employment opportunity associated with design work.

[199] Total residential buildings in Bridgeport equal 22,866 (Bridgeport Tax Assessor data). Average electricity use and electricity-related emissions per building are calculated from Bridgeport 2007 GHG Inventory data which had input of 330,415,655 kWh for residential sector electricity use and related emissions of 137,169 MTCO2e, to yield a per building electricity consumption average of 14,450 kWh/year and electricity-related emissions equal to 6.0 MTCO2e. This Energy Plan assumes a 4KW solar pv system supplies 4,800 kWh electricity (derived from conversation with Sunlight Solar Energy, which indicates an average sized system of 5KW installed (for average site use of 1,000 kWh/month, or 12,000 kWh/year) delivers annual electricity equal to 5,800 to 6,000 kWh and a 5KW system installed averages 28 to 30 panels and requires roof space of 450 to 500 square feet for installation).

[200] Upon recommendation of ICLEI, Bridgeport GHG Inventory conducted for calendar year 2007 used Egrid Subregion 1 – NPCC New England coefficient figures for 2004 as follows: CO2 908.9 lbs/MWH; N20 0.015 lbs/MWH; CH4 0.080 lbs/MWH and criteria air pollutants as follows: NOX 0.677 lbs/MWH; SOX 1.262 lbs/MWH; CO 1.216 lbs/MWH; VOC 0.136 lbs/MWH; PM10 0.982 lbs/MWH. Electricity emissions are calculated from Bridgeport GHG Inventory, which had input of 762,419,176 total kWh community-wide and reported 316,511 MTCO2e of electricity-related emissions community-wide for average of 0.000415141 MTCO2e/kWh.

[201]Rounding accounts for difference in figures.

[202] Dollar savings are calculated using 2010 utility costs of $0.24/kWh electricity (includes all fees); $9.18/thousand cf natural gas for commercial/industrial and $14.81/thousand cf natural gas for residential; $2.65/ gallon #2 light fuel oil; $3.00/gallon gasoline/diesel (assumes 1 average price per gallon); $0.00735/ gallon water residential supply and $0.005/gallon water commercial/industrial supply; $0.002166/gallon cost to residents and businesses for water treatment; $0.00018/gallon cost to utility associated with electricity to supply water; $0.000234/gallon cost associated with electricity used to WPCA to treat water.

[203] The Connecticut Energy Advisory Board reports that solar module prices are expected to drop as much as 30 percent in the next year or two, which would reduce installed costs about 15 percent from the current average installed cost of $7.50/watt for all systems. (Smaller systems cost more than this average per watt; larger systems cost less per watt.) The CEAB also notes that industry goals reported by SolarBuzz are a drop from $4+/watt to $1.5 to $2/watt by 2020 for module costs. Installed costs declined from $7.8/watt in 2007 to $7.5/watt in 2008. As a result of current and projected solar economics, CEAB currently recommends a delay in implementing significant solar installation as a means of meeting Connecticut's electricity supply. (CEAB Technical Paper: Renewable Energy; http://www.ctenergy.org/pdf/2010CEABPPPart4b2.pdf. Cited in this paper, and referenced here, is information from Lawrence Berkeley National Laboratory, Tracking the Sun II (LBNL report), October 2009.)

[204] Employment calculation assumes installation requirements are as follows: 13 man-days per residential site for installation of a 4KW system. This figure does not include employment opportunity associated with design work.

[205] Connecticut Clean Energy Fund website indicates 70% of hot water heating needs at typical home may be met through solar thermal installation, with a fuel savings equivalent of 7.7 gallons of heating oil and nearly 3.5 $MTCO_2e$ avoidance (Connecticut Clean Energy Fund, http://www.ctcleanenergy.com; searched June 2010).

[206] Residential building number from Bridgeport Tax Assessor data.

[207] Assumes fuel savings of 7.7 gallons of heating oil equivalent per building. For this Bridgeport Energy Plan, energy savings are calculated assuming a 50%/50% oil/natural gas contribution based on 47%/52% split between oil heat and gas heat in Bridgeport residential heating systems (Bridgeport Tax Assessor).

[208] Emissions calculated from Bridgeport 2007 GHG inventory averages. Bridgeport GHG Inventory for calendar year 2007 had input of 3,998,557 thousand cubic feet of natural gas community-wide and reported 228,616 MTCO2e of natural gas-related emissions community-wide for average of 0.057175 MTCO2e/thousand cf. Bridgeport GHG Inventory for calendar year 2007 had input of 9,585 thousand gallons of light fuel oil community-wide and reported 100,588 MTCO2e of light fuel oil-related emissions community-wide for average of 9.367 MTCO2e/thousand gallons of fuel oil

[209] This Bridgeport Energy Plan assumes installation of a 3-collector solar thermal system on residential buildings. A 3-collector solar thermal system is considered sufficient for 3-4 person house, is capable of producing 13.75 MMBtu's per year and requires 25 square feet roof space, or a total of 75 square feet of roof space for system installation. A 2-collector system is considered sufficient for a 2- to 3-person house, generates 9.3 MMBtu's per year, and requires 50 square feet of roof space for installation (Sunlight Solar Energy).

[210] Dollar savings are calculated using 2010 utility costs of $0.24/kWh electricity (includes all fees); $9.18/thousand cf natural gas for commercial/industrial and $14.81/thousand cf natural gas for residential; $2.65/ gallon #2 light fuel oil; $3.00/gallon gasoline/diesel (assumes 1 average price per gallon); $0.00735/ gallon water residential supply and $0.005/gallon water commercial/industrial supply; $0.002166/gallon cost to residents and businesses for water treatment; $0.00018/gallon cost to utility associated with electricity to supply water; $0.000234/gallon cost associated with electricity used to WPCA to treat water.

[211] The Connecticut Energy Advisory Board reports that solar module prices are expected to drop as much as 30 percent in the next year or two, which would reduce installed costs about 15 percent from the current average installed cost of $7.50/watt for all systems. (Smaller systems cost more than this average per watt; larger systems cost less per watt.) The CEAB also notes that industry goals reported by SolarBuzz are a drop from $4+/watt to $1.5 to $2/watt by 2020 for module costs. Installed costs declined from $7.8/watt in 2007 to $7.5/watt in 2008. As a result of current and projected solar economics, CEAB currently recommends a delay in implementing significant solar installation as a means of meeting Connecticut's electricity supply. (CEAB Technical Paper: Renewable Energy; http://www.ctenergy.org/pdf/2010CEABPPPart4b2.pdf. Cited in this paper, and referenced here, is information from Lawrence Berkeley National Laboratory, Tracking the Sun II (LBNL report), October 2009.)

[212] The calculation of employment opportunity assumes the following: for a 3-panel system, 3 installers for 3 days are required for total of 9 man-days per installation (Mercury Solar Systems rough guideline).

[213] Flat roof commercial buildings equal 1,531 (63%) of 2,446 total commercial buildings (Bridgeport Tax Assessor data) but have living space equal to 76% of total commercial living area (from Bridgeport Tax Assessor data). The per building energy use, calculated based upon 76% of total commercial electricity consumption: (76% X 432,003,521 kWh)/1,531 building number, yields 214,450-kWh/year per flat roof commercial building. kWh savings from solar pv installation are calculated to be 87,258 kWh per flat roof commercial building, or 41% of electricity consumption, based on following assumptions: total footprint of 1,531 flat roof commercial buildings equals 14,843,484 square feet (from Bridgeport Tax Assessor data) for per building average footprint of 148,435 square feet. Space required for installation of 1KW solar PV system equals 100 square feet (Mercury Solar Systems). Maximum installed potential on Bridgeport commercial flat roof buildings, based on roof space available, equals 148,435 KW, having generation potential of 178,121,808 kWh (assuming 1,200 kWh generation per 1 KW installed (United Illuminating)). Total installed capacity per building equals 97KW and total annual generation potential per building equals 116,343 kWh. This Energy Plan assumes 25% reduction from maximum potential, yielding 87,258 kWh per building adjusted savings potential from 73 KW installed solar PV per building average. This equals 40.69% of 2007 electricity consumption per building average for flat roof commercial buildings and carries an associated 20% reduction in per building electricity-related emissions (36.22 MTCO2e versus 180.1 MTCO2e per flat roof commercial building average from Bridgeport GHG Inventory data).

[214] Flat roof commercial buildings equal 1,531 (63%) of 2,446 total commercial buildings) (Bridgeport Tax Assessor data) but have living space equal to 76% of total commercial living area (from Bridgeport Tax Assessor data). Per building energy use calculated based upon 76% of total commercial electricity consumption (76% X 432,003,521 kWh)/1,531 building number, yielding 214,450-kWh/year per flat roof commercial building. kWh savings from solar pv installation calculated to be 87,258 kWh per flat roof commercial building, or 20% of electricity consumption, based on following assumptions: total footprint of 1,531 flat roof commercial buildings equals 14,843,484 square feet (from Bridgeport Tax Assessor data) for per building average of 148,435 square feet. Space required for installation of 1KW solar PV equals 100 square feet (Mercury Solar Systems). Total installed potential on Bridgeport commercial flat roof buildings equals 148,435 KW, having generation potential of 178,121,808 kWh based on 1,200 kWh generation per 1 KW installed (United Illuminating), or total installed capacity per building of 97KW and total annual generation per building of 116,343 kWh. This Energy Plan assumes 25% reduction from maximum potential, yielding 87,258 kWh per building adjusted savings potential from 73 KW installed solar PV per building average. This equals 40.69% of 2007 per building electricity consumption average for flat roof commercial buildings.

[215] Upon recommendation of ICLEI, Bridgeport GHG Inventory conducted for calendar year 2007 used Egrid Subregion 1 – NPCC New England coefficient figures for 2004 as follows: CO2 908.9 lbs/MWH; N20 0.015 lbs/MWH; CH4 0.080 lbs/MWH and criteria air pollutants as follows: NOX 0.677 lbs/MWH; SOX 1.262 lbs/MWH; CO 1.216 lbs/MWH; VOC 0.136 lbs/MWH; PM10 0.982 lbs/MWH. Electricity emissions are calculated from Bridgeport GHG Inventory, which had input of 762,419,176 total kWh community-wide and reported 316,511 MTCO2e of electricity-related emissions community-wide for average of 0.000415141 MTCO2e/kWh. Savings per flat roof commercial building represent 20% electricity-related emissions savings per flat roof commercial building: 36.22 MTCO2e savings / 180.07 MTCO2e building average for flat roof commercial buildings from Bridgeport 2007 GHG Inventory data.

[216] Total footprint of 1,531 flat roof commercial buildings equals 14,843,484 square feet (from Bridgeport Tax Assessor data) for a per building average of 148,435 square feet. Space required for installation of 1KW solar PV equals 100 square feet (Mercury Solar Systems). Total installed potential on Bridgeport commercial flat roof buildings equals 148,435 KW, having generation potential of 178,121,808 kWh based on 1,200 kWh generation per 1 KW installed (United Illuminating), or total installed capacity per building of 97KW and total annual generation per building of 116,343 kWh. This Energy Plan assumes 25% reduction from maximum potential; yielding 87,258 kWh per building adjusted savings potential from 73 KW installed solar PV per building average.

[217] Dollar savings are calculated using 2010 utility costs of $0.24/kWh electricity (includes all fees); $9.18/thousand cf natural gas for commercial/industrial and $14.81/thousand cf natural gas for residential; $2.65/ gallon #2 light fuel oil; $3.00/gallon gasoline/diesel (assumes 1 average price per gallon); $0.00735/ gallon water residential supply and $0.005/gallon water commercial/industrial supply; $0.002166/gallon cost to residents and businesses for water treatment; $0.00018/gallon cost to utility associated with electricity to supply water; $0.000234/gallon cost associated with electricity used to WPCA to treat water.

[218] The Connecticut Energy Advisory Board reports that solar module prices are expected to drop as much as 30 percent in the next year or two, which would reduce installed costs about 15 percent from the current average installed cost of $7.50/watt for all systems. (Smaller systems cost more than this average per watt; larger systems cost less per watt.) The CEAB also notes that industry goals reported by SolarBuzz are a drop from $4+/watt to $1.5 to $2/watt by 2020 for module costs. Installed costs declined from $7.8/watt in 2007 to $7.5/watt in 2008. As a result of current and projected solar economics, CEAB currently recommends a delay in implementing significant solar installation as a means of meeting Connecticut's electricity supply. (CEAB Technical Paper: Renewable Energy; http://www.ctenergy.org/pdf/2010CEABPPPart4b2.pdf. Cited in this paper, and referenced here, is information from Lawrence Berkeley National Laboratory, Tracking the Sun II (LBNL report), October 2009.)

[219] This employment opportunity calculation assumes this measure would require 3 installers for 2 to 2.25 months = 50 days/installer, or 150 man-days per installation, and does not include design-related employment opportunity (Mercury Solar Systems, rough guideline).

[220] Pitched roof commercial buildings equal 915 (37%) of 2,446 total commercial buildings (Bridgeport Tax Assessor data) but have living space equal to 24% of total commercial living area (from Bridgeport Tax Assessor data). The per building energy use, calculated based upon 24% of total commercial electricity consumption: (24% X 432,003,521 kWh)/915 building number, yields 113,312 kWh/year per pitched roof commercial building. kWh savings from solar pv installation are calculated to be 54,358 kWh per pitched roof commercial building, or 48% of electricity consumption, based on following assumptions: total footprint of 915 flat roof commercial buildings equals 5,526,364 square feet (from Bridgeport Tax Assessor data) for per building average footprint of 6,040 square feet. Space required for installation of 1KW solar PV system equals 100 square feet (Mercury Solar Systems). Assumed maximum installed potential on Bridgeport commercial pitched roof buildings is 25%, based on 50% elimination for roof orientation and 50% reduction of remaining based on shading or other factors, resulting in adjusted maximum installed potential of 13,816 KW, having generation potential of 16,579,092 kWh (assuming 1,200 kWh generation per 1 KW installed (United Illuminating)). Total installed capacity per building equals 60KW and total annual generation potential per building equals 72,477 kWh. This Energy Plan assumes 25% reduction from maximum potential; yielding 54,358 kWh per building adjusted savings potential from 45 KW installed solar PV per building average. This equals 48% of 2007 electricity consumption per building average for pitched roof commercial buildings and carries an associated 24% reduction in per building electricity-related emissions (22.57MTCO2e versus 95.14 MTCO2e per pitched roof commercial building average from Bridgeport GHG Inventory data).

[221] Pitched roof commercial buildings equal 915 (37%) of 2,446 total commercial buildings (Bridgeport Tax Assessor data) but have living space equal to 24% of total commercial living area (from Bridgeport Tax Assessor data). The per building energy use, calculated based upon 24% of total commercial electricity consumption: (24% X 432,003,521 kWh)/915 building number, yields 113,312 kWh/year per pitched roof commercial building. kWh savings from solar pv installation are calculated to be 54,358 kWh per pitched roof commercial building, or 48% of electricity consumption, based on following assumptions: total footprint of 915 flat roof commercial buildings equals 5,526,364 square feet (from Bridgeport Tax Assessor data) for per building average footprint of 6,040 square feet. Space required for installation of 1KW solar PV system equals 100 square feet (Mercury Solar Systems). Assumed maximum installed potential on Bridgeport commercial pitched roof buildings is 25%, based on 50% elimination for roof orientation and 50% reduction of remaining based on shading or other factors, resulting in adjusted maximum installed potential of 13,816 KW, having generation potential of 16,579,092 kWh (assuming 1,200 kWh generation per 1 KW installed (United Illuminating)). Total installed capacity per building equals 60KW and total annual generation potential per building equals 72,477 kWh. This Energy Plan assumes 25% reduction from maximum potential; yielding 54,358 kWh per building adjusted savings potential from 45 KW installed solar PV per building average. This equals 48% of 2007 electricity consumption per building average for pitched roof commercial buildings and carries an associated 24% reduction in per building electricity-related emissions (22.57MTCO2e versus 95.14 MTCO2e per pitched roof commercial building average from Bridgeport GHG Inventory data).

[222] Upon recommendation of ICLEI, Bridgeport GHG Inventory conducted for calendar year 2007 used Egrid Subregion 1 – NPCC New England coefficient figures for 2004 as follows: CO2 908.9 lbs/MWH; N20 0.015 lbs/MWH; CH4 0.080 lbs/MWH and criteria air pollutants as follows: NOX 0.677 lbs/MWH; SOX 1.262 lbs/MWH; CO 1.216 lbs/MWH; VOC 0.136 lbs/MWH; PM10 0.982 lbs/MWH. Electricity emissions are calculated from Bridgeport GHG Inventory, which had input of 762,419,176 total kWh community-wide and reported 316,511 MTCO2e of electricity-related emissions community-wide for average of 0.000415141 MTCO2e/kWh. Savings per pitched roof commercial building represent 24% electricity-related emissions savings per pitched roof commercial building: 22.57 MTCO2e savings / 95.14 MTCO2e pitched roof commercial building average from Bridgeport GHG Inventory data.

[223] Total footprint of 915 pitched roof commercial buildings equals 5,526,364 square feet (from Bridgeport Tax Assessor data) for per building average footprint of 6,040 square feet. Space required for installation of 1KW solar PV system equals 100 square feet (Mercury Solar Systems). Assumed maximum installed potential on Bridgeport commercial pitched roof buildings is 25%, based on 50% elimination for roof orientation and 50% reduction of remaining based on shading or shape factors, resulting in adjusted maximum installed potential of 13,816 KW, having generation potential of 16,579,092 kWh (assuming 1,200 kWh generation per 1 KW installed (United Illuminating)). Total installed capacity per building equals 60KW and total annual generation potential per building equals 72,477 kWh. This Energy Plan assumes 25% reduction from maximum potential; yielding 54,358 kWh per building adjusted savings potential from 45 KW installed solar PV per building average.

[224] Dollar savings are calculated using 2010 utility costs of $0.24/kWh electricity (includes all fees); $9.18/thousand cf natural gas for commercial/industrial and $14.81/thousand cf natural gas for residential; $2.65/ gallon #2 light fuel oil; $3.00/gallon gasoline/diesel (assumes 1 average price per gallon); $0.00735/ gallon water residential supply and $0.005/gallon water commercial/industrial supply; $0.002166/gallon cost to residents and businesses for water treatment; $0.00018/gallon cost to utility associated with electricity to supply water; $0.000234/gallon cost associated with electricity used to WPCA to treat water.

[225] The Connecticut Energy Advisory Board reports that solar module prices are expected to drop as much as 30 percent in the next year or two, which would reduce installed costs about 15 percent from the current average installed cost of $7.50/watt for all systems. (Smaller systems cost more than this average per watt; larger systems cost less per watt.) The CEAB also notes that industry goals reported by SolarBuzz are a drop from $4+/watt to $1.5 to $2/watt by 2020 for module costs. Installed costs declined from $7.8/watt in 2007 to $7.5/watt in 2008. As a result of current and projected solar economics, CEAB currently recommends a delay in implementing significant solar installation as a means of meeting Connecticut's electricity supply. (CEAB Technical Paper: Renewable Energy; http://www.ctenergy.org/pdf/2010CEABPPPart4b2.pdf. Cited in this paper, and referenced here, is information from Lawrence Berkeley National Laboratory, Tracking the Sun II (LBNL report), October 2009.)

[226] This employment opportunity calculation assumes this measure would require 3 installers for 2 to 2.25 months = 50 days/installer, or 150 man-days per installation, and does not include design-related employment opportunity (Mercury Solar Systems, rough guideline).

[227] This Bridgeport Energy Plan assumes installation of solar under Low Growth scenario on flat roof buildings only. Flat roof commercial buildings equal 1,531 (63%) of 2,446 total commercial buildings (Bridgeport Tax Assessor data) but have living space equal to 76% of total commercial living area (from Bridgeport Tax Assessor data). The per building energy use, calculated based upon 76% of total commercial electricity consumption: (76% X 432,003,521 kWh)/1,531 building number, yields 214,450-kWh/year per flat roof commercial building. kWh savings from solar pv installation are calculated to be 87,258 kWh per flat roof commercial building, or 41% of electricity consumption, based on following assumptions: total footprint of 1,531 flat roof commercial buildings equals 14,843,484 square feet (from Bridgeport Tax Assessor data) for per building average footprint of 148,435 square feet. Space required for installation of 1KW solar PV system equals 100 square feet (Mercury Solar Systems). Maximum installed potential on Bridgeport commercial flat roof buildings, based on roof space available, equals 148,435 KW, having generation potential of 178,121,808 kWh (assuming 1,200 kWh generation per 1 KW installed (United Illuminating)). Total installed capacity per building equals 97KW and total annual generation potential per building equals 116,343 kWh. This Energy Plan assumes 25% reduction from maximum potential, yielding 87,258 kWh per building adjusted savings potential from 73 KW installed solar PV per building average. This equals 40.69% of 2007 electricity consumption per building average for flat roof commercial buildings and carries an associated 20% reduction in per building electricity-related emissions (36.22 MTCO2e versus 180.1 MTCO2e per flat roof commercial building average from Bridgeport GHG Inventory data).

[228] Flat roof commercial buildings equal 1,531 (63%) of 2,446 total commercial buildings(Bridgeport Tax Assessor data) but have living space equal to 76% of total commercial living area (from Bridgeport Tax Assessor data). Per building energy use calculated based upon 76% of total commercial electricity consumption (76% X 432,003,521 kWh)/1,531 building number, yielding 214,450-kWh/year per flat roof commercial building. kWh savings from solar pv installation calculated to be 87,258 kWh per flat roof commercial building, or 20% of electricity consumption, based on following assumptions: total footprint of 1,531 flat roof commercial buildings equals 14,843,484 square feet (from Bridgeport Tax Assessor data) for per building average of 148,435 square feet. Space required for installation of 1KW solar PV equals 100 square feet (Mercury Solar Systems). Total installed potential on Bridgeport commercial flat roof buildings equals 148,435 KW, having generation potential of 178,121,808 kWh based on 1,200 kWh generation per 1 KW installed (United Illuminating), or total installed capacity per building of 97KW and total annual generation per building of 116,343 kWh. This Energy Plan assumes 25% reduction from maximum potential, yielding 87,258 kWh per building adjusted savings potential from 73 KW installed solar PV per building average. This equals 40.69% of 2007 per building electricity consumption average for flat roof commercial buildings.

[229] Upon recommendation of ICLEI, Bridgeport GHG Inventory conducted for calendar year 2007 used Egrid Subregion 1 – NPCC New England coefficient figures for 2004 as follows: CO2 908.9 lbs/MWH; N20 0.015 lbs/MWH; CH4 0.080 lbs/MWH and criteria air pollutants as follows: NOX 0.677 lbs/MWH; SOX 1.262 lbs/MWH; CO 1.216 lbs/MWH; VOC 0.136 lbs/MWH; PM10 0.982 lbs/MWH. Electricity emissions are calculated from Bridgeport GHG Inventory, which had input of 762,419,176 total kWh community-wide and reported 316,511 MTCO2e of electricity-related emissions community-wide for average of 0.000415141 MTCO2e/kWh. Savings per flat roof commercial building represent 20% electricity-related emissions savings per flat roof commercial building: 36.22 MTCO2e savings / 180.07 MTCO2e building average for flat roof commercial buildings from Bridgeport 2007 GHG Inventory data.

[230] Dollar savings are calculated using 2010 utility costs of $0.24/kWh electricity (includes all fees); $9.18/thousand cf natural gas for commercial/industrial and $14.81/thousand cf natural gas for residential; $2.65/ gallon #2 light fuel oil; $3.00/gallon gasoline/diesel (assumes 1 average price per gallon); $0.00735/ gallon water residential supply and $0.005/gallon water commercial/industrial supply; $0.002166/gallon cost to residents and businesses for water treatment; $0.00018/gallon cost to utility associated with electricity to supply water; $0.000234/gallon cost associated with electricity used to WPCA to treat water.

[231] Rounding impacts total.

[232] Dollar savings are calculated using 2010 utility costs of $0.24/kWh electricity (includes all fees); $9.18/thousand cf natural gas for commercial/industrial and $14.81/thousand cf natural gas for residential; $2.65/ gallon #2 light fuel oil; $3.00/gallon gasoline/diesel (assumes 1 average price per gallon); $0.00735/ gallon water residential supply and $0.005/gallon water commercial/industrial supply; $0.002166/gallon cost to residents and businesses for water treatment; $0.00018/gallon cost to utility associated with electricity to supply water; $0.000234/gallon cost associated with electricity used to WPCA to treat water.

[233] The Connecticut Energy Advisory Board reports that solar module prices are expected to drop as much as 30 percent in the next year or two, which would reduce installed costs about 15 percent from the current average installed cost of $7.50/watt for all systems. (Smaller systems cost more than this average per watt; larger systems cost less per watt.) The CEAB also notes that industry goals reported by SolarBuzz are a drop from $4+/watt to $1.5 to $2/watt by 2020 for module costs. Installed costs declined from $7.8/watt in 2007 to $7.5/watt in 2008. As a result of current and projected solar economics, CEAB currently recommends a delay in implementing significant solar installation as a means of meeting Connecticut's electricity supply. (CEAB Technical Paper: Renewable Energy; http://www.ctenergy.org/pdf/2010CEABPPPart4b2.pdf. Cited in this paper, and referenced here, is information from Lawrence Berkeley National Laboratory, Tracking the Sun II (LBNL report), October 2009.)

[234] New England Governors' Renewable Energy Blueprint, 2009; http://www.negc.org/documents/2009/Renewable_Energy.pdf

[235] 2010 Comprehensive Plan For the Procurement of Energy Resources Prepared by the Connecticut Energy Advisory Board, April 27, 2010; http://ctenergy.org/pdf/2010FullPlan.pdf

[236] 2010 Comprehensive Plan For the Procurement of Energy Resources Prepared by the Connecticut Energy Advisory Board, April 27, 2010; http://ctenergy.org/pdf/2010FullPlan.pdf

[237] 2010 Connecticut Energy Advisory Board Procurement Plan, CEAB Technical Paper: Emerging Technologies, http://www.ctenergy.org/pdf/2010CEABPPPart4b1.pdf.

[238] Negative energy and emissions savings for electricity reflect increase in electricity and related emissions resulting from added train travel. Measure includes only vehicle miles travelled within Bridgeport boundaries, for consistency with Bridgeport 2007 GHG Inventory. Maximum regional rail service (MetroNorth) trip length in Bridgeport is assumed to be 4 miles round trip (2 miles between Bridgeport station and Bridgeport/Fairfield border or 2 miles between Bridgeport station and Bridgeport/Stratford boarder. Increased electricity use from rail use derived from Bridgeport 2007 GHG Inventory, which used input of 2,996 Btu/passenger-mile and 3,412 Btu/kWh for 0.878077374 kWh/passenger mile. Gasoline savings are calculated based on Bridgeport 2007 GHG Inventory, which had gasoline input of 27,018 thousand gallons (U.S) and diesel input of 5,301 thousand gallons for total input of 32,319 thousand gallons and VMT input of 475,513,500 gasoline-powered vehicle miles traveled (VMT) and 29,061,450 diesel-powered VMT for total input of 504,574,950 VMT.

[239] Upon recommendation of ICLEI, Bridgeport GHG Inventory conducted for calendar year 2007 used Egrid Subregion 1 – NPCC New England coefficient figures for 2004 as follows: CO2 908.9 lbs/MWH; N20 0.015 lbs/MWH; CH4 0.080 lbs/MWH and criteria air pollutants as follows: NOX 0.677 lbs/MWH; SOX 1.262 lbs/MWH; CO 1.216 lbs/MWH; VOC 0.136 lbs/MWH; PM10 0.982 lbs/MWH. Electricity emissions are calculated from Bridgeport GHG Inventory, which had input of 762,419,176 total kWh community-wide and reported 316,511 $MTCO_2e$ of electricity-related emissions community-wide for average of 0.000415141 $MTCO_2e$/kWh. Gasoline equivalent emissions are calculated from Bridgeport 2007 GHG Inventory, which had gasoline input of 27,018 thousand gallons (U.S) and diesel input of 5,301 thousand gallons for total input of 32,319 thousand gallons. This Bridgeport Energy Plan assumes a single emissions average for gasoline and diesel combined. Based on reported emissions of 313,960 $MTCO_2e$ for citywide roadway transportation, average roadway emissions equal 0.009714409 metric tons/gallon of "gasoline". Bridgeport 2007 GHG inventory had input of 475,513,500 gasoline-powered vehicle miles traveled (VMT) and 29,061,450 diesel-powered VMT for total input of 504,574,950 VMT. Average emissions based on Bridgeport citywide roadway VMT for gasoline and diesel VMT combined, and single fuel consumption figure for gasoline and diesel combined equals 0.000622227 $MTCO_2e$ per vehicle mile travelled.

[240] The 4-mile roundtrip distance is used because a trip east or west on the MetroNorth railway with Bridgeport as the starting point will travel roughly 2 miles within Bridgeport to the border with either Stratford or Fairfield.

[241] Dollar savings are calculated using 2010 utility costs of $0.24/kWh electricity (includes all fees); $9.18/thousand cf natural gas for commercial/industrial and $14.81/thousand cf natural gas for residential; $2.65/ gallon #2 light fuel oil; $3.00/gallon gasoline/diesel (assumes 1 average price per gallon); $0.00735/ gallon water residential supply and $0.005/gallon water commercial/industrial supply; $0.002166/gallon cost to residents

and businesses for water treatment; $0.00018/gallon cost to utility associated with electricity to supply water; $0.000234/gallon cost associated with electricity used to WPCA to treat water.

[242] ICF International and American Public Transportation Association, Public Transportation and Petroleum Savings in the U.S.: Reducing Dependence on Foreign Oil. 2007, cited in Center for Neighborhood Technology, 2008, Chicago Greenhouse Gas Emissions: An Inventory, Forecast, and Mitigation Analysis for Chicago and the Metropolitan Region; an assessment prepared for the City of Chicago http://www.chicagoclimateaction.org/filebin/pdf/FINALALL091708_1-118.pdf).

[243] Negative energy and emissions savings for electricity reflect increase in electricity and related emissions resulting from added train travel. Measure includes only vehicle miles travelled within Bridgeport boundaries, for consistency with Bridgeport 2007 GHG Inventory. Measure assumes one 9-person occupancy van travels 8 roundtrips/day (4 morning and 4 afternoon.) X 2 miles X 250 days/year = 4000 VMT per year, carrying 36 persons for net annual VMT savings of 14,000. Assumes van fuel efficiency is 10 mpg so gallons of fuel used by van per year are 4000/10 =400 for annual savings of 753 gallons. Maximum regional rail service (MetroNorth) trip length in Bridgeport is assumed to be 4 miles round trip (2 miles between Bridgeport station and Bridgeport/Fairfield border or 2 miles between Bridgeport station and Bridgeport/Stratford boarder. Increased electricity use from rail use derived from Bridgeport 2007 GHG Inventory, which used input of 2,996 Btu/passenger-mile and 3,412 Btu/kWh for 0.878077374 kWh/passenger mile. Gasoline savings are calculated based on Bridgeport 2007 GHG Inventory, which had gasoline input of 27,018 thousand gallons (U.S) and diesel input of 5,301 thousand gallons for total input of 32,319 thousand gallons and VMT input of 475,513,500 gasoline-powered vehicle miles traveled (VMT) and 29,061,450 diesel-powered VMT for total input of 504,574,950 VMT.

[244] Upon recommendation of ICLEI, Bridgeport GHG Inventory conducted for calendar year 2007 used Egrid Subregion 1 – NPCC New England coefficient figures for 2004 as follows: CO2 908.9 lbs/MWH; N20 0.015 lbs/MWH; CH4 0.080 lbs/MWH and criteria air pollutants as follows: NOX 0.677 lbs/MWH; SOX 1.262 lbs/MWH; CO 1.216 lbs/MWH; VOC 0.136 lbs/MWH; PM10 0.982 lbs/MWH. Electricity emissions are calculated from Bridgeport GHG Inventory, which had input of 762,419,176 total kWh community-wide and reported 316,511 $MTCO_2e$ of electricity-related emissions community-wide for average of 0.000415141 $MTCO_2e$/kWh. Gasoline equivalent emissions are calculated from Bridgeport 2007 GHG Inventory, which had gasoline input of 27,018 thousand gallons (U.S) and diesel input of 5,301 thousand gallons for total input of 32,319 thousand gallons. This Bridgeport Energy Plan assumes a single emissions average for gasoline and diesel combined. Based on reported emissions of 313,960 $MTCO_2e$ for citywide roadway transportation, average roadway emissions equal 0.009714409 metric tons CO_2e/gallon of "gasoline." Bridgeport 2007 GHG inventory had input of 475,513,500 gasoline-powered vehicle miles traveled (VMT) and 29,061,450 diesel-powered VMT for total input of 504,574,950 VMT. Average emissions based on Bridgeport citywide roadway VMT for gasoline and diesel VMT combined, and single fuel consumption figure for gasoline and diesel combined equals 0.000622227 $MTCO_2e$ per vehicle mile travelled.

[245] Dollar savings are calculated using 2010 utility costs of $0.24/kWh electricity (includes all fees); $9.18/thousand cf natural gas for commercial/industrial and $14.81/thousand cf natural gas for residential; $2.65/ gallon #2 light fuel oil; $3.00/gallon gasoline/diesel (assumes 1 average price per gallon); $0.00735/ gallon water residential supply and $0.005/gallon water commercial/industrial supply; $0.002166/gallon cost to residents and businesses for water treatment; $0.00018/gallon cost to utility associated with electricity to supply water; $0.000234/gallon cost associated with electricity used to WPCA to treat water.

[246] Annual gasoline/diesel savings per person for transfer from single rider auto trip to Bridgeport 4-mile roundtrip train trip is calculated from Bridgeport GHG Inventory data as follows: (250 day) X (5 days/week) = 1,000 vehicle miles/year. (1,000 vehicle miles) X (0.000622227 $MTCO_2e$ average from GHG inventory report) = 0.22226 $MTCO_2e$, which is divided by 0.009714409 metric tons CO_2e/gallon average from Bridgeport GHG Inventory, to yield 64.05 gallons per person/year. At assumed $3/gallon, savings per person equals $192.15. Note that the average vehicle efficiency per vehicle generated by the Bridgeport 2007 GHG Inventory is 15.61 mpg.

[247] Labor potential calculation assumes 1 driver per van per half day for 5 days per week; so 1 FT equivalent per 2 vans.

[248] This measure assumes shift per person from SOV to bus for 6-mile roundtrip X 330 days/year =19,800 VMT per person per year. It also assumes shift from 21.3 mpg passenger vehicle to 5.6 mpg bus and shift in occupancy factor from 1.60 to 10.6.

[249] Fuel savings and emissions from this measure were calculated with Clean Air and Climate Protection (CACP) software, developed by the National Association of Clean Air Agencies (formerly STAPPA and ALAPCO), ICLEI-Local Governments for Sustainability (formerly International Cities for Local Environmental Action (ICLEI)), and Torrie Smith Associates Inc. Default values for software are 0.009393 metric tons CO_2e/gallon gasoline and 0.009791 metric tons CO_2e/gallon diesel.

[250] Dollar savings are calculated using 2010 utility costs of $0.24/kWh electricity (includes all fees); $9.18/thousand cf natural gas for commercial/industrial and $14.81/thousand cf natural gas for residential; $2.65/ gallon #2 light fuel oil; $3.00/gallon gasoline/diesel (assumes 1 average price per gallon); $0.00735/ gallon water residential supply and $0.005/gallon water commercial/industrial supply; $0.002166/gallon cost to residents and businesses for water treatment; $0.00018/gallon cost to utility associated with electricity to supply water; $0.000234/gallon cost associated with electricity used to WPCA to treat water.

[251] Savings calculation based on annual gasoline/diesel savings per person for transfer from single rider auto trip to Bridgeport 4-mile roundtrip train trip, which is calculated from Bridgeport GHG Inventory data as follows: (250 day) X (5 days/week) = 1,000 vehicle miles/year. (1,000 vehicle miles) X (0.000622227 $MTCO_2e$ average from GHG inventory report) = 0.22226 $MTCO_2e$, which is divided by 0.009714409 metric tons CO_2e/gallon average from Bridgeport GHG Inventory, to yield 64.05 gallons per person/year. At assumed $3/gallon, savings per person equals $192.15. A similar transfer of six-mile trips, as proposed by this measure, would save ($192/4) X (6) = $288. Note that the average vehicle efficiency per vehicle generated by the Bridgeport 2007 GHG Inventory is 15.61 mpg.

[252] An ecopass currently costs $80 (Greater Bridgeport Transit).

[253] This measure assumes shift from passenger car with average 1.6 occupancy factor and 21.3 mpg fuel efficiency to bus with 10.6 occupancy factor and 5.6 mpg average fuel efficiency.

[254] Fuel savings and emissions from this measure were calculated with Clean Air and Climate Protection (CACP) software, developed by the National Association of Clean Air Agencies (formerly STAPPA and ALAPCO), ICLEI-Local Governments for Sustainability (formerly International Cities for Local Environmental Action (ICLEI)), and Torrie Smith Associates Inc. Default values for software are 0.009393 metric tons CO_2e/gallon gasoline and 0.009791 metric tons CO_2e/gallon diesel.

[255] The number of automobiles removed from the roadway was estimated based on the following assumptions: East/West trip on I-95 equals 4 miles and N/S trip on Route 8/25 equals 6 miles. Assume 50/50 reduction of number of trips between the two routes to yield 5,000,000 trips removed (and decrease of 20,000,000 SOV VMT) from I-95; and 3,333,333 trips removed (and decrease of 20,000,000 SOV VMT) from Route 8/25. Cars per day removed equals 13,699 for I-95 and 9,132 for Route 8/25 for combined total of 22,831 cars based on these mileage/trip assumptions.

[256] Dollar savings are calculated using 2010 utility costs of $0.24/kWh electricity (includes all fees); $9.18/thousand cf natural gas for commercial/industrial and $14.81/thousand cf natural gas for residential; $2.65/ gallon #2 light fuel oil; $3.00/gallon gasoline/diesel (assumes 1 average price per gallon); $0.00735/ gallon water residential supply and $0.005/gallon water commercial/industrial supply; $0.002166/gallon cost to residents and businesses for water treatment; $0.00018/gallon cost to utility associated with electricity to supply water; $0.000234/gallon cost associated with electricity used to WPCA to treat water.

[257] VMT projection is based on increasing trend in per capita VMT.

[258] Energy and emissions savings assume workday carpooling for 3-mile round trip travel within Bridgeport X 250 days per year; and assume 4:1 ratio of 2-person to 3-person carpools. Miles travelled energy savings and emissions savings associated with carpooling beyond Bridgeport boundaries are not quantified or included in Bridgeport savings potential. Gasoline savings are calculated based on Bridgeport 2007 GHG Inventory, which had gasoline input of 27,018 thousand gallons (U.S) and diesel input of 5,301 thousand gallons for total input of 32,319 thousand gallons and VMT input of 475,513,500 gasoline-powered vehicle miles traveled (VMT) and 29,061,450 diesel-powered VMT for total input of 504,574,950 VMT.

[259] Gasoline equivalent emissions are calculated from Bridgeport 2007 GHG Inventory, which had gasoline input of 27,018 thousand gallons (U.S) and diesel input of 5,301 thousand gallons for total input of 32,319 thousand gallons. This Bridgeport Energy Plan assumes a single emissions average for gasoline and diesel combined. Based on reported emissions of 313,960 $MTCO_2e$ for citywide roadway transportation, average roadway emissions equal 0.009714409 metric tons CO_2e/gallon of "gasoline." Bridgeport 2007 GHG inventory had input of 475,513,500 gasoline-powered vehicle miles traveled (VMT) and 29,061,450 diesel-powered VMT for total input of 504,574,950 VMT. Average emissions based on Bridgeport citywide roadway VMT for gasoline and diesel VMT combined, and single fuel consumption figure for gasoline and diesel combined equals 0.000622227 $MTCO_2e$ per vehicle mile travelled.

[260] Dollar savings are calculated using 2010 utility costs of $0.24/kWh electricity (includes all fees); $9.18/thousand cf natural gas for commercial/industrial and $14.81/thousand cf natural gas for residential; $2.65/ gallon #2 light fuel oil; $3.00/gallon gasoline/diesel (assumes 1 average price per gallon); $0.00735/ gallon water residential supply and $0.005/gallon water commercial/industrial supply; $0.002166/gallon cost to residents

and businesses for water treatment; $0.00018/gallon cost to utility associated with electricity to supply water; $0.000234/gallon cost associated with electricity used to WPCA to treat water.

[261] Five carpools with a ratio of 4:1 2-person to 3-person are estimated to have savings of $1,729 based on $3/gallon gasoline cost and 576-gallon savings per year. Using these figures, the price per person for 11 persons equals $157.

[262] Energy and emissions savings assume the establishment of one 8-person vanpool at 10 Bridgeport employment hubs to service 80 persons; and assumes travel of 6-miles round trip X 250 days/year = 1,500 VMT per person.

[263] Gasoline equivalent emissions are calculated from Bridgeport 2007 GHG Inventory, which had gasoline input of 27,018 thousand gallons (U.S) and diesel input of 5,301 thousand gallons for total input of 32,319 thousand gallons. This Bridgeport Energy Plan assumes a single emissions average for gasoline and diesel combined. Based on reported emissions of 313,960 $MTCO_2e$ for citywide roadway transportation, average roadway emissions equal 0.009714409 metric tons CO_2e/gallon of "gasoline." Bridgeport 2007 GHG inventory had input of 475,513,500 gasoline-powered vehicle miles traveled (VMT) and 29,061,450 diesel-powered VMT for total input of 504,574,950 VMT. Average emissions based on Bridgeport citywide roadway VMT for gasoline and diesel VMT combined, and single fuel consumption figure for gasoline and diesel combined equals 0.000622227 $MTCO_2e$ per vehicle mile travelled.

[264] Rounding impacts total number

[265] Dollar savings are calculated using 2010 utility costs of $0.24/kWh electricity (includes all fees); $9.18/thousand cf natural gas for commercial/industrial and $14.81/thousand cf natural gas for residential; $2.65/ gallon #2 light fuel oil; $3.00/gallon gasoline/diesel (assumes 1 average price per gallon); $0.00735/ gallon water residential supply and $0.005/gallon water commercial/industrial supply; $0.002166/gallon cost to residents and businesses for water treatment; $0.00018/gallon cost to utility associated with electricity to supply water; $0.000234/gallon cost associated with electricity used to WPCA to treat water.

[266] This action assumes 20-shared cars are established to serve 874 persons, which equals 43.7 persons per car. Car-share assumes gasoline savings factor versus non-car share equals 10. These assumptions mirror assumptions of the Chicago Climate Mitigation Analysis (Center for Neighborhood Technology, 2008, Chicago Greenhouse Gas Emissions: An Inventory, Forecast, and Mitigation Analysis for Chicago and the Metropolitan Region; An assessment prepared for the City of Chicago; http://www.chicagoclimateaction.org/filebin/pdf/FINALALL091708_118-266.pdf) which cites the GHG reduction potential of car sharing used is calculated based on the long-term study of City CarShare in San Francisco carried out by Robert Cervero et al, which found that the average car share member consumes just 0.03 gallons of gasoline per day for all trips in all modes, while the average nonmember consumes 0.31 gallons, or ten times more. At the time of the study, City CarShare had 3,800 active members and 87 vehicles, for an average of 43.7 active members per vehicle (Robert Cervero, Aaron Golub, and Brendan Nee, Institute of Urban and Regional Development, University of California at Berkeley, "San Francisco City CarShare: Longer-Term Travel-Demand and Car Ownership Impacts," Department of Transportation and Parking, City of San Francisco, http://www-iurd.ced.berkeley.edu/pub/WP-2006-07.pdf.)

[267] AT 0.3 gallons per day, one non-car share driver would use 109.5 gallons of gasoline per year, log 20,14.8 VMT (assuming 18.4 mpg fuel efficiency) and emit 1.2537 $MTCO_2e$ (assuming Bridgeport average transportation roadway emissions of 0.000622227 $MTCO_2e$/gallon of gasoline derived from Bridgeport 2007 GHG Inventory input of 32,319 thousand gallons gasoline and diesel and software-generated emissions of 313,960 $MTCO_2e$). 43.7 non-car-share drivers would use 4,785.15 gallons of gasoline, log 88,046.76 VMT and emit 54.78504387 MT of CO2e per year. In comparison, a single car-share driver, assuming .03 gallons of gasoline per day, would use 10.95 gallons of gasoline per year, log 201.48 VMT per year and emit 0.12537 MT of CO2e per year. 43.7 car-share drivers would use 478.52 gallons of gasoline per year, log 8,804.68 VMT per year and emit 5.4785 $MTCO_2e$ per year. The per driver difference between a non-car share driver and a car-share driver, and used for these Bridgeport Energy Plan calculations, is 4,306.635 gallons per year, 79,242.084 VMT and 49.30653948 $MTCO_2e$.

[268] Gasoline equivalent emissions are calculated from Bridgeport 2007 GHG Inventory, which had gasoline input of 27,018 thousand gallons (U.S) and diesel input of 5,301 thousand gallons for total input of 32,319 thousand gallons. This Bridgeport Energy Plan assumes a single emissions average for gasoline and diesel combined. Based on reported emissions of 313,960 $MTCO_2e$ for citywide roadway transportation, average roadway emissions equal 0.009714409 metric tons CO_2e/gallon of "gasoline." Bridgeport 2007 GHG inventory had input of 475,513,500 gasoline-powered vehicle miles traveled (VMT) and 29,061,450 diesel-powered VMT for total input of 504,574,950 VMT. Average emissions based on Bridgeport citywide roadway VMT for gasoline and diesel VMT combined, and single fuel consumption figure for gasoline and diesel combined equals 0.000622227 $MTCO^2_e$ per vehicle mile travelled.

[269] Dollar savings are calculated using 2010 utility costs of $0.24/kWh electricity (includes all fees); $9.18/thousand cf natural gas for commercial/industrial and $14.81/thousand cf natural gas for residential; $2.65/ gallon #2 light fuel oil; $3.00/gallon gasoline/diesel (assumes 1 average price per gallon); $0.00735/ gallon water residential supply and $0.005/gallon water commercial/industrial supply; $0.002166/gallon cost to residents and businesses for water treatment; $0.00018/gallon cost to utility associated with electricity to supply water; $0.000234/gallon cost associated with electricity used to WPCA to treat water.

[270] As cited in Center for Neighborhood Technology, 2008, Chicago Greenhouse Gas Emissions: An Inventory, Forecast, and Mitigation Analysis for Chicago and the Metropolitan Region; An assessment prepared for the City of Chicago; http://www.chicagoclimateaction.org/filebin/pdf/FINALALL091708_1-118.pdf): ZipCar, www.zipcar.com\/chicago/is-it/compare-own; and Philly Car Share, www.phillycarshare.org/24/news/press-room.

[271] This measure assumes transportation-related emissions associated with new housing units located in Bridgeport's inner core will elicit 62% lower net increase due to TOD versus new construction in outlying suburbs. Modeling for Stamford, Connecticut showed this result for hypothetical construction of 6,113 new housing units in Stamford Downtown and serves as the basis for this assumption (RPA and ICLEI, Mayors Institute on Climate Change, 2009). Modeling used ICLEI transportation and land use software. This Energy Plan assumes 2.7 persons per household, for total of 27,000 persons in projected 10,000 new households under the High Growth scenario. Per person (and per household) VMT is calculated based upon 2007 population of 137,463 population and 2007 citywide VMT of 504,574,950, for 2007 per capita average of 3,671 VMT/person, and is then adjusted to reflect the state trend (19.90% projected increase 2007 to 2030 as derived from State of Connecticut sector emissions trends for years 1990 to 2007 and comparison of 5-year averages of 1990-1994 and 2003-2007). The 2030 projected VMT/person used in this Bridgeport Energy Plan is 4,401. Projected emissions are based upon this figure and no adjustment is made for changes in fuel efficiency. Under these assumptions, projected VMT from 10,000 additional households is 118,827,000 vehicle miles. A 62% lower net increase is 73,672,740 vehicle miles for a difference of 45,154,260 VMT.

[272] Gasoline equivalent emissions are calculated from Bridgeport 2007 GHG Inventory, which had gasoline input of 27,018 thousand gallons (U.S) and diesel input of 5,301 thousand gallons for total input of 32,319 thousand gallons. This Bridgeport Energy Plan assumes a single emissions average for gasoline and diesel combined. Based on reported emissions of 313,960 $MTCO_2e$ for citywide roadway transportation, average roadway emissions equal 0.009714409 metric tons CO_2e/gallon of "gasoline." Bridgeport 2007 GHG inventory had input of 475,513,500 gasoline-powered vehicle miles traveled (VMT) and 29,061,450 diesel-powered VMT for total input of 504,574,950 VMT. Average emissions based on Bridgeport citywide roadway VMT for gasoline and diesel VMT combined, and single fuel consumption figure for gasoline and diesel combined equals 0.000622227 $MTCO_2e$ per vehicle mile travelled.

[273] Gasoline equivalent emissions are calculated from Bridgeport 2007 GHG Inventory, which had gasoline input of 27,018 thousand gallons (U.S) and diesel input of 5,301 thousand gallons for total input of 32,319 thousand gallons. This Bridgeport Energy Plan assumes a single emissions average for gasoline and diesel combined. Based on reported emissions of 313,960 $MTCO_2e$ for citywide roadway transportation, average roadway emissions equal 0.009714409 metric tons CO_2e/gallon of "gasoline." Bridgeport 2007 GHG inventory had input of 475,513,500 gasoline-powered vehicle miles traveled (VMT) and 29,061,450 diesel-powered VMT for total input of 504,574,950 VMT. Average emissions based on Bridgeport citywide roadway VMT for gasoline and diesel VMT combined, and single fuel consumption figure for gasoline and diesel combined equals 0.000622227 $MTCO_2e$ per vehicle mile travelled.

[274] Dollar savings are calculated using 2010 utility costs of $0.24/kWh electricity (includes all fees); $9.18/thousand cf natural gas for commercial/industrial and $14.81/thousand cf natural gas for residential; $2.65/ gallon #2 light fuel oil; $3.00/gallon gasoline/diesel (assumes 1 average price per gallon); $0.00735/ gallon water residential supply and $0.005/gallon water commercial/industrial supply; $0.002166/gallon cost to residents and businesses for water treatment; $0.00018/gallon cost to utility associated with electricity to supply water; $0.000234/gallon cost associated with electricity used to WPCA to treat water.

[275] Peter M. Haas, et. al., "Housing & Transportation Cost Trade-offs and Burdens of Working Households in 28 Metros," Center for Neighborhood Technology and Virginia Tech, http://www.cnt.org/repository/H-T-Tradeoffs-for-Working-Families-n-28-Metros-FULL.pdf.; cited in Center for Neighborhood Technology, 2008, Chicago Greenhouse Gas Emissions: An Inventory, Forecast, and Mitigation Analysis for Chicago and the Metropolitan Region; An assessment prepared for the City of Chicago; http://www.chicagoclimateaction.org/filebin/pdf/FINALALL091708_1-118.pdf).

[276] Dena Belzer, et. al., "Preserving and Promoting Diverse Transit-Oriented Development," Center for Neighborhood Technology, http://www.cnt.org/repository/diverseTOD_FullReport.pdf.; cited in Center for Neighborhood Technology, 2008, Chicago Greenhouse Gas Emissions: An Inventory, Forecast, and Mitigation Analysis for Chicago and the Metropolitan Region; An assessment prepared for the City of Chicago; http://www.chicagoclimateaction.org/filebin/pdf/FINALALL091708_1-118.pdf).

[277] Center for Neighborhood Technology, 2008, Chicago Greenhouse Gas Emissions: An Inventory, Forecast, and Mitigation Analysis for Chicago and the Metropolitan Region; An assessment prepared for the City of Chicago; http://www.chicagoclimateaction.org/filebin/pdf/FINALALL091708_1-118.pdf).

[278] In 2009, as part of a regional emissions evaluation, Regional Plan Association and ICLEI conducted modeling for Stamford, Connecticut, using ICLEI's transportation and land use software. Modeling results showed that hypothetical construction of 6,113 new housing units in Stamford Downtown, as opposed to construction in surrounding municipalities, resulted in a 62% lower net increase in transportation-related emissions. Development outside of the urban center was predicted to result in an additional 178,859,913 VMT annually compared to 67,795,133 additional VMT per year resulting from Downtown development (RPA and ICLEI, Mayors Institute on Climate Change,2009).

[279] RPA and ICLEI, Mayors Institute on Climate Change, 2009.

[280] Gasoline equivalent emissions are calculated from Bridgeport 2007 GHG Inventory, which had gasoline input of 27,018 thousand gallons (U.S) and diesel input of 5,301 thousand gallons for total input of 32,319 thousand gallons. This Bridgeport Energy Plan assumes a single emissions average for gasoline and diesel combined. Based on reported emissions of 313,960 $MTCO_2e$ for citywide roadway transportation, average roadway emissions equal 0.009714409 metric tons CO_2e/gallon of "gasoline." Bridgeport 2007 GHG inventory had input of 475,513,500 gasoline-powered vehicle miles traveled (VMT) and 29,061,450 diesel-powered VMT for total input of 504,574,950 VMT. Average emissions based on Bridgeport citywide roadway VMT for gasoline and diesel VMT combined, and single fuel consumption figure for gasoline and diesel combined equals 0.000622227 $MTCO_2e$ per vehicle mile travelled. Calculation yields 389.87 gallons of gasoline/diesel.

[281]Dena Belzer, et. al., "Preserving and Promoting Diverse Transit-Oriented Development," Center for Neighborhood Technology, http://www.cnt.org/repository/diverseTOD_FullReport.pdf.; cited in Center for Neighborhood Technology, 2008, Chicago Greenhouse Gas Emissions: An Inventory, Forecast, and Mitigation Analysis for Chicago and the Metropolitan Region; An assessment prepared for the City of Chicago; http://www.chicagoclimateaction.org/filebin/pdf/FINALALL091708_1-118.pdf).

[282] The proposed program participation and VMT reduction targets in this goal are based upon RPA analysis of Bridgeport's in-city travel patterns, but actual action items are developed independently. Census tract information reveals 357,901 VMT for work-related trips within 1 mile of the destination. This Bridgeport Energy Plan assumes work-related travel equals 20% of total travel and assumes the same proportion of non-work trips is located within 1 mile of the destination. Regardless of adherence to Census-tract-derived data and targets, this Bridgeport Energy Plan proposes transfer of trips under 1-mile to reduce automobile VMT by 201,300 miles and transfer of additional trips under 2-miles to reduce automobile VMT by 264,000 miles, for a total combined savings of 465,300 VMT (approximately equal to 464,850 VMT in action item's goal).

[283] Gasoline equivalent emissions are calculated from Bridgeport 2007 GHG Inventory, which had gasoline input of 27,018 thousand gallons (U.S) and diesel input of 5,301 thousand gallons for total input of 32,319 thousand gallons. This Bridgeport Energy Plan assumes a single emissions average for gasoline and diesel combined. Based on reported emissions of 313,960 $MTCO_2e$ for citywide roadway transportation, average roadway emissions equal 0.009714409 metric tons/gallon of "gasoline". Bridgeport 2007 GHG inventory had input of 475,513,500 gasoline-powered vehicle miles traveled (VMT) and 29,061,450 diesel-powered VMT for total input of 504,574,950 VMT. Average emissions based on Bridgeport citywide roadway VMT for gasoline and diesel VMT combined, and single fuel consumption figure for gasoline and diesel combined equals 0.000622227 MT per vehicle mile travelled.

[284] Gasoline equivalent emissions are calculated from Bridgeport 2007 GHG Inventory, which had gasoline input of 27,018 thousand gallons (U.S) and diesel input of 5,301 thousand gallons for total input of 32,319 thousand gallons. This Bridgeport Energy Plan assumes a single emissions average for gasoline and diesel combined. Based on reported emissions of 313,960 $MTCO_2e$ for citywide roadway transportation, average roadway emissions equal 0.009714409 metric tons CO_2e/gallon of "gasoline." Bridgeport 2007 GHG inventory had input of 475,513,500 gasoline-powered vehicle miles traveled (VMT) and 29,061,450 diesel-powered VMT for total input of 504,574,950 VMT. Average emissions based on Bridgeport citywide roadway VMT for gasoline and diesel VMT combined, and single fuel consumption figure for gasoline and diesel combined equals 0.000622227 $MTCO_2e$ per vehicle mile travelled.

[285] Dollar savings are calculated using 2010 utility costs of $0.24/kWh electricity (includes all fees); $9.18/thousand cf natural gas for commercial/industrial and $14.81/thousand cf natural gas for residential; $2.65/ gallon #2 light fuel oil; $3.00/gallon gasoline/diesel (assumes 1 average price per gallon); $0.00735/ gallon water residential supply and $0.005/gallon water commercial/industrial supply; $0.002166/gallon cost to residents and businesses for water treatment; $0.00018/gallon cost to utility associated with electricity to supply water; $0.000234/gallon cost associated with electricity used to WPCA to treat water.

[286] Dollar savings are calculated using 2010 utility costs of $0.24/kWh electricity (includes all fees); $9.18/thousand cf natural gas for commercial/industrial and $14.81/thousand cf natural gas for residential; $2.65/ gallon #2 light fuel oil; $3.00/gallon gasoline/diesel (assumes 1 average price per gallon); $0.00735/ gallon water residential supply and $0.005/gallon water commercial/industrial supply; $0.002166/gallon cost to residents and businesses for water treatment; $0.00018/gallon cost to utility associated with electricity to supply water; $0.000234/gallon cost associated with electricity used to WPCA to treat water.

[287] Input data for Bridgeport 2007 GHG Inventory, RPA, 2008 was gallons of gasoline or gallons of diesel, and VMT was derived from these inputs.

[288] Gasoline equivalent emissions are calculated from Bridgeport 2007 GHG Inventory, which had gasoline input of 27,018 thousand gallons (U.S) and diesel input of 5,301 thousand gallons for total input of 32,319 thousand gallons. This Bridgeport Energy Plan assumes a single emissions average for gasoline and diesel combined. Based on reported emissions of 313,960 $MTCO_2e$ for citywide roadway transportation, average roadway emissions equal 0.009714409 metric tons CO_2e/gallon of "gasoline." Bridgeport 2007 GHG inventory had input of 475,513,500 gasoline-powered vehicle miles traveled (VMT) and 29,061,450 diesel-powered VMT for total input of 504,574,950 VMT. Average emissions based on Bridgeport citywide roadway VMT for gasoline and diesel VMT combined, and single fuel consumption figure for gasoline and diesel combined equals 0.000622227 $MTCO_2e$ per vehicle mile travelled.

[289] Dollar savings are calculated using 2010 utility costs of $0.24/kWh electricity (includes all fees); $9.18/thousand cf natural gas for commercial/industrial and $14.81/thousand cf natural gas for residential; $2.65/ gallon #2 light fuel oil; $3.00/gallon gasoline/diesel (assumes 1 average price per gallon); $0.00735/ gallon water residential supply and $0.005/gallon water commercial/industrial supply; $0.002166/gallon cost to residents and businesses for water treatment; $0.00018/gallon cost to utility associated with electricity to supply water; $0.000234/gallon cost associated with electricity used to WPCA to treat water.

[290] Fuel savings and emissions from this measure were calculated with Clean Air and Climate Protection (CACP) software, developed by the National Association of Clean Air Agencies (formerly STAPPA and ALAPCO), ICLEI-Local Governments for Sustainability (formerly International Cities for Local Environmental Action (ICLEI)), and Torrie Smith Associates Inc. Default values for software are 0.009393 metric tons CO_2e/gallon gasoline and 0.009791 metric tons CO_2e/gallon diesel. This action uses 12,000 VMT input per vehicle. Fuel savings are reported in gasoline equivalent savings, and do not split into gasoline savings and CNG increased consumption.

[291] Dollar savings are calculated using 2010 utility costs of $0.24/kWh electricity (includes all fees); $9.18/thousand cf natural gas for commercial/industrial and $14.81/thousand cf natural gas for residential; $2.65/ gallon #2 light fuel oil; $3.00/gallon gasoline/diesel (assumes 1 average price per gallon); $0.00735/ gallon water residential supply and $0.005/gallon water commercial/industrial supply; $0.002166/gallon cost to residents and businesses for water treatment; $0.00018/gallon cost to utility associated with electricity to supply water; $0.000234/gallon cost associated with electricity used to WPCA to treat water.

[292] Center for Neighborhood Technology, 2008, Chicago Greenhouse Gas Emissions: An Inventory, Forecast, and Mitigation Analysis for Chicago and the Metropolitan Region; An assessment prepared for the City of Chicago; http://www.chicagoclimateaction.org/filebin/pdf/FINALALL091708_1-118.pdf.

[293] 2010 CEAB Procurement Plan, CEAB Technical Paper: Emerging Technologies http://www.ctenergy.org/pdf/2010CEABPPPart4b1.pdf.

[294] 2010 CEAB Procurement Plan, CEAB Technical Paper: Emerging Technologies http://www.ctenergy.org/pdf/2010CEABPPPart4b1.pdf.

[295] Enviro Express, conversation.

[296] Fuel savings and emissions from this measure were calculated with Clean Air and Climate Protection (CACP) software, developed by the National Association of Clean Air Agencies (formerly STAPPA and ALAPCO), ICLEI-Local Governments for Sustainability (formerly International Cities for Local Environmental Action (ICLEI)), and Torrie Smith Associates Inc. Default values for software are 0.009393 metric tons CO_2e/gallon gasoline and 0.009791 metric tons CO_2e/gallon diesel. Upon recommendation of ICLEI, Bridgeport GHG Inventory conducted for calendar year 2007 used Egrid Subregion 1 – NPCC New England coefficient figures for 2004 as follows: CO2 908.9 lbs/MWH; N20 0.015 lbs/MWH; CH4 0.080 lbs/MWH and criteria air pollutants as follows: NOX 0.677 lbs/MWH; SOX 1.262 lbs/MWH; CO 1.216 lbs/MWH; VOC 0.136 lbs/MWH; PM10 0.982 lbs/MWH. Electricity emissions are calculated from Bridgeport GHG Inventory, which had input of 762,419,176 total kWh community-wide and reported 316,511 $MTCO_2e$ of electricity-related emissions community-wide for average of 0.000415141 $MTCO_2e$/kWh. This action uses 12,000 VMT input per vehicle. Fuel savings are reported in gasoline equivalent savings, and do not split into gasoline savings and kWh electricity increased consumption.

[297] Dollar savings are calculated using 2010 utility costs of $0.24/kWh electricity (includes all fees); $9.18/thousand cf natural gas for commercial/industrial and $14.81/thousand cf natural gas for residential; $2.65/ gallon #2 light fuel oil; $3.00/gallon gasoline/diesel (assumes 1 average price per gallon); $0.00735/ gallon water residential supply and $0.005/gallon water commercial/industrial supply; $0.002166/gallon cost to residents and businesses for water treatment; $0.00018/gallon cost to utility associated with electricity to supply water; $0.000234/gallon cost associated with electricity used to WPCA to treat water.

[298] Fuel savings are based on information generated by Clean Air and Climate Protection (CACP) software, developed by the National Association of Clean Air Agencies (formerly STAPPA and ALAPCO), ICLEI-Local Governments for Sustainability (formerly International Cities for Local Environmental Action (ICLEI)), and Torrie Smith Associates Inc. and do not provide detailed split of gasoline savings and increased kWh purchase. Energy savings and cost savings are based solely on gasoline equivalents and gasoline cost of $3.00/gallon.

[299]2010 CEAB Procurement Plan, CEAB Technical Paper: Emerging Technologies http://www.ctenergy.org/pdf/2010CEABPPPart4b1.pdf .

[300] 2010 CEAB Procurement Plan, CEAB Technical Paper: Emerging Technologies http://www.ctenergy.org/pdf/2010CEABPPPart4b1.pdf.

[301] 2010 CEAB Procurement Plan, CEAB Technical Paper: Emerging Technologies http://www.ctenergy.org/pdf/2010CEABPPPart4b1.pdf.

[302] 2010 CEAB Procurement Plan, CEAB Technical Paper: Emerging Technologies http://www.ctenergy.org/pdf/2010CEABPPPart4b1.pdf.

[303] Fuel savings and emissions reductions are based on information generated by Clean Air and Climate Protection (CACP) software, developed by the National Association of Clean Air Agencies (formerly STAPPA and ALAPCO), ICLEI-Local Governments for Sustainability (formerly International Cities for Local Environmental Action (ICLEI)), and Torrie Smith Associates Inc. Per vehicle energy and emissions savings are based on 12,000 annual VMT per vehicle and shift from 18.4 mpg to 24 mpg for average passenger vehicle.

[304] This is approximately 100 five mile “thru” trips, if 6 mile Route 8/25 trip is averaged with 4 mile Route I95 trip. Reducing emissions in 110,000,000 5-mile thru trips per year is equivalent to reducing emissions in 301,370 thru trips per day. This number of trips exceeds current Route 8/25 and I95 trip number, but citywide VMT is projected by this Bridgeport Energy Plan to increase with upward trend of 19.90% by 2030 (derived from State of Connecticut sector emissions trends for years 1990 to 2007 and comparison of 5-year averages of 1990-1994 and 2003-2007).

[305] Dollar savings are calculated using 2010 utility costs of $0.24/kWh electricity (includes all fees); $9.18/thousand cf natural gas for commercial/industrial and $14.81/thousand cf natural gas for residential; $2.65/ gallon #2 light fuel oil; $3.00/gallon gasoline/diesel (assumes 1 average price per gallon); $0.00735/ gallon water residential supply and $0.005/gallon water commercial/industrial supply; $0.002166/gallon cost to residents and businesses for water treatment; $0.00018/gallon cost to utility associated with electricity to supply water; $0.000234/gallon cost associated with electricity used to WPCA to treat water.

[306] Savings calculation of gasoline savings is based on a shift from 18.4 mpg to 24 mpg. This shift saves 63 gallons of gasoline for every 5,000 vehicle miles travelled. Cost savings are calculated at $3 per gallon.

[307] MSW incinerated and recycled tonnage from Bridgeport 2007 GHG Inventory, RPA, 2008, with input from Bridgeport Public Facilities Recycling and RESCO.

[308] Emissions calculated for Bridgeport 2007 GHG Inventory using Clean Air and Climate Protection (CACP) software, developed by the National Association of Clean Air Agencies (formerly STAPPA and ALAPCO), ICLEI-Local Governments for Sustainability (formerly International Cities for Local Environmental Action (ICLEI)), and Torrie Smith Associates Inc. (Bridgeport 2007 GHG Inventory, RPA, 2008)

[309] See Appendix for calculations associated with projections related to recycling and associated emissions. Recycling projections for Bridgeport assume a population increase from 137, 463 to 151,740 (increase of 14,277 persons) between 2007 to 2030 under the Low Growth scenario and a population increase to 162,463 persons (increase of 25,000 persons over 2007 baseline, and increase of 10,723 over Low Growth projected population) under the High Growth scenario.

[310] Full implementation is targeted to a 2015 completion, but percentages noted in this implementation schedule include certain action beyond 2015 to account for future household creation under the Low Growth scenario.

[311] Cost savings for recycling result from savings of tipping fee at incineration facility equal to $63/ton MSW.

[312] Cost savings for recycling result from savings of tipping fee at incineration facility equal to $63/ton MSW.

[313] In less than a year, Stamford, CT increased municipal recycling tonnage 39%, as a result of a switch to single stream. Magdalene Perez, Single-stream system lifts recycling 39 percent in Stamford, The Stamford Advocate, July 26, 2010.

[314] Center for Neighborhood Technology, 2008, Chicago Greenhouse Gas Emissions: An Inventory, Forecast, and Mitigation Analysis for Chicago and the Metropolitan Region; An assessment prepared for the City of Chicago; http://www.chicagoclimateaction.org/filebin/pdf/FINALALL091708_1-118.pdf).

[315] Aquarion reports 2010 average residential customer usage in Bridgeport of 105,000 gallons of water, which is down from 2007 average residential customer usage of 111,200 gallons.

[316] 2007 Households derived from CT State Data Center: Rodriguez, Orlando, 2007. Bridgeport, CT Population Projection from 2010 to 2030 by Age, Ethnicity and Sex Distributions, Connecticut State Data Center, University of Connecticut, Storrs, Connecticut, and assuming linear growth between 2005 and 2010.

[317] This action assumes installation of one low flow showerhead, which represents a switch from an average of 4 GPM to 2.2 GPR rate of flow.

[318] Energy required to treat water through Bridgeport's water treatment system is calculated from the following: total electricity used by Bridgeport WPCA in 2007 (WPCA for Bridgeport 2007 GHG Inventory input) equaled 16,836,833 kWh and average flow for total system equaled 29.5 million gallons per day, which equals 10,767,500,000 gallons per year, for average of 0.001563672 kWh/gallon of water required for water treatment. Energy used for water supply is calculated from customer usage figures from Aquarion, which reports 111,200 gallons/residential customer usage in 2007 and 105,000 gallons/residential customer usage in 2010. System-wide, Aquarion reports energy required to supply and distribute water averages 1,200 kWh/million gallons water (=0.0012 kWh/gallon). Combined energy requirement for supply/distribution and treatment is the sum of these two numbers, which equals 0.002763672 kWh/gallon. Electricity savings are calculated based upon water savings reported in UI and CL&P Program Savings Documentation for 2010 Program Year, pages 161-162, which equal 4,271 gallons/showerhead per year.

[319] Upon recommendation of ICLEI, Bridgeport GHG Inventory conducted for calendar year 2007 used Egrid Subregion 1 – NPCC New England coefficient figures for 2004 as follows: CO2 908.9 lbs/MWH; N20 0.015 lbs/MWH; CH4 0.080 lbs/MWH and criteria air pollutants as follows: NOX 0.677 lbs/MWH; SOX 1.262 lbs/MWH; CO 1.216 lbs/MWH; VOC 0.136 lbs/MWH; PM10 0.982 lbs/MWH. Bridgeport inventory had input of 762,419,176 total kWh community-wide and reported 316,511 $MTCO_2e$ of electricity-related emissions for community-wide average of 0.000415141 $MTCO_2e$/kWh. Electricity emissions savings are calculated based upon this coefficient.

[320] Energy savings recorded here are only for energy required for supply and treatment of water. See the Green Buildings section of this Bridgeport Energy plan for energy and emissions savings related to decreased fuel use resulting from efficient appliances. Water savings potential from Low Flow Showerhead installation are from UI and CL&P Program Savings Documentation for 2010 Program Year, pages 161-162: HES and Low Income; average 4 to 2.2 GPM low flow showerheads, water savings equals 4,271 gallons/year per head.

[321] Water, water-related-energy savings, and emissions savings reported in this Water Resources section of the Bridgeport Energy Plan may result from actions detailed in separate parts of this energy plan.

[322] Assumes installation of two faucet aerators which each reduce flow from 2.2 to 1.5 GPM.

[323] Energy required to treat water through Bridgeport's water treatment system is calculated from the following: total electricity used by Bridgeport WPCA in 2007 (WPCA for Bridgeport 2007 GHG Inventory input) equaled 16,836,833 kWh and average flow for total system equaled 29.5 million gallons per day, which equals 10,767,500,000 gallons per year, for average of 0.001563672 kWh/gallon of water required for water treatment. Energy used for water supply is calculated from customer usage figures from Aquarion, which reports 111,200 gallons/residential customer usage in 2007 and 105,000 gallons/residential customer usage in 2010. System-wide, Aquarion reports energy required to supply and distribute water averages 1,200 kWh/million gallons water (=0.0012 kWh/gallon). Combined energy requirement for supply/distribution and treatment is the sum of these two numbers, which equals 0.002763672 kWh/gallon. Electricity savings are calculated based upon water savings reported in UI and CL&P Program Savings Documentation for 2010 Program Year, pages 163-164, which equals 255.5 gallons per aerator per year.

[324] Upon recommendation of ICLEI, Bridgeport GHG Inventory conducted for calendar year 2007 used Egrid Subregion 1 – NPCC New England coefficient figures for 2004 as follows: CO2 908.9 lbs/MWH; N20 0.015 lbs/MWH; CH4 0.080 lbs/MWH and criteria air pollutants as follows: NOX 0.677 lbs/MWH; SOX 1.262 lbs/MWH; CO 1.216 lbs/MWH; VOC 0.136 lbs/MWH; PM10 0.982 lbs/MWH. Bridgeport inventory had input of 762,419,176 total kWh

community-wide and reported 316,511 $MTCO_2e$ of electricity-related emissions for community-wide average of 0.000415141 $MTCO_2e$/kWh. Electricity emissions savings are calculated based upon this coefficient.

[325] Energy savings recorded here are only for energy required for supply and treatment of water. See the Green Buildings section of this Bridgeport Energy plan for energy and emissions savings related to decreased fuel use resulting from efficient appliances. Water savings potential from faucet aerator installation is from UI and CL&P Program Savings Documentation for 2010 Program Year, pages 163-164: Faucet Aerator 2.2 to 1.5 GPM water savings gallons/year/faucet; water savings equals 255.5 gallons per aerator.

[326] Rounding accounts for numerical difference.

[327] Electricity savings and related emissions reduction calculated from assumed water savings of 10,237 gallons/year per fixture for change out of 3.5 gallons fixture to 1.6 gallon fixture. This assumes water savings of 3,541 gallons/person/year and 2.89 persons per household.

[328] Energy required to treat water through Bridgeport's water treatment system is calculated from the following: total electricity used by Bridgeport WPCA in 2007 (WPCA for Bridgeport 2007 GHG Inventory input) equaled 16,836,833 kWh and average flow for total system equaled 29.5 million gallons per day, which equals 10,767,500,000 gallons per year, for average of 0.001563672 kWh/gallon of water required for water treatment. Energy used for water supply is calculated from customer usage figures from Aquarion, which reports 111,200 gallons/residential customer usage in 2007 and 105,000 gallons/residential customer usage in 2010. System-wide, Aquarion reports energy required to supply and distribute water averages 1,200 kWh/million gallons water (=0.0012 kWh/gallon). Combined energy requirement for supply/distribution and treatment is the sum of these two numbers, which equals 0.002763672 kWh/gallon. Electricity savings for this action are calculated based upon assumed water savings of 10,237 gallons/fixture/year.

[329] Upon recommendation of ICLEI, Bridgeport GHG Inventory conducted for calendar year 2007 used Egrid Subregion 1 – NPCC New England coefficient figures for 2004 as follows: CO2 908.9 lbs/MWH; N20 0.015 lbs/MWH; CH4 0.080 lbs/MWH and criteria air pollutants as follows: NOX 0.677 lbs/MWH; SOX 1.262 lbs/MWH; CO 1.216 lbs/MWH; VOC 0.136 lbs/MWH; PM10 0.982 lbs/MWH. Bridgeport inventory had input of 762,419,176total kWh community-wide and reported 316,511 $MTCO_2e$ of electricity-related emissions for community-wide average of 0.000415141 $MTCO_2e$/kWh. Electricity emissions savings are calculated based upon this coefficient.

[330] Water savings of 10,237 gallons/year per fixture for change out of 3.5 gallons fixture to 1.6 gallon fixture are calculated based upon 3,541 gallons/person/years savings and 2.89 persons per household (DeOreo, et. al. 2001, H2ouse website, "Toilet water use rates, non- conserving and conserving homes," reports a 9.7 gallon reduction per person per day, resulting from shift from 3.6 gallon/flush to 1.54 gallon/flush). Household number derived from Bridgeport 2007 population of 137,463 and household number of 47,543 from Connecticut Data Center (Rodriguez, Orlando, 2007. Bridgeport, CT Population Projection from 2010 to 2030 by Age, Ethnicity and Sex Distributions, Connecticut State Data Center, University of Connecticut, Storrs, Connecticut, and assuming linear growth between 2005 and 2010).

[331] This represents 50% of households (2007 Households derived from CT State Data Center: Rodriguez, Orlando, 2007. Bridgeport, CT Population Projection from 2010 to 2030 by Age, Ethnicity and Sex Distributions, Connecticut State Data Center, University of Connecticut, Storrs, Connecticut, and assuming linear growth between 2005 and 2010).

[332] Rounding contributes to difference in total.

[333]Energy required to treat water through Bridgeport's water treatment system is calculated from the following: total electricity used by Bridgeport WPCA in 2007 (WPCA for Bridgeport 2007 GHG Inventory input) equaled 16,836,833 kWh and average flow for total system equaled 29.5 million gallons per day, which equals 10767500000 gallons per year, for average of 0.001563672 kWh/gallon of water required for water treatment. Energy used for water supply is calculated from customer usage figures from Aquarion, which reports 111,200 gallons/residential customer usage in 2007 and 105,000 gallons/residential customer usage in 2010. System-wide, Aquarion reports energy required to supply and distribute water averages 1,200 kWh/million gallons water (=0.0012 kWh/gallon). Combined energy requirement for supply/distribution and treatment is the sum of these two numbers, which equals 0.002763672 kWh/gallon. Electricity savings are calculated based upon water savings reported in UI and CL&P Program Savings Documentation for 2010 Program Year, pages 123-125: equals 5.598 gallons/year.

[334] Upon recommendation of ICLEI, Bridgeport GHG Inventory conducted for calendar year 2007 used Egrid Subregion 1 – NPCC New England coefficient figures for 2004 as follows: CO2 908.9 lbs/MWH; N20 0.015 lbs/MWH; CH4 0.080 lbs/MWH and criteria air pollutants as follows: NOX 0.677 lbs/MWH; SOX 1.262 lbs/MWH; CO 1.216 lbs/MWH; VOC 0.136 lbs/MWH; PM10 0.982 lbs/MWH. Bridgeport inventory had input of 762,419,176total kWh

community-wide and reported 316,511 $MTCO_2e$ of electricity-related emissions for community-wide average of 0.000415141 $MTCO_2e$/kWh. Electricity emissions savings are calculated based upon this coefficient.

[335] Energy savings recorded here are only for energy required for supply and treatment of water. See the Green Buildings section of this Bridgeport Energy plan for energy and emissions savings related to decreased fuel use resulting from efficient appliances. Water savings potential from clothes washer trade-in are from UI and CL&P Program Savings Documentation for 2010 Program Year, pages123-125: Clothes Washer (Retail Products, HES & Low Income) annual difference between old and new Energy Star (July 2009) for Early Retirement gross Annual Savings Water Heater and Dryer Fuel Type Unknown i.e. Retail Sales. This Energy Report uses this single year figure for all annual savings figures, and does not include a separate early retirement savings; water savings equals 5.598 gallons/year.

[336] Rounding contributes to difference in total.

[337] Aquarion reports kits include aerator, dye tablets to check for leaks, bags for leak check, and informational brochure on water conservation measures.

[338] This action assumes 40% water savings potential based on USGBC reports (U.S. Green Building Council, Why Build Green? http://www.usgbc.org/DisplayPage.aspx?CMSPageID=1720)

[339] Energy required to treat water through Bridgeport's water treatment system is calculated from the following: total electricity used by Bridgeport WPCA in 2007 (WPCA for Bridgeport 2007 GHG Inventory input) equaled 16,836,833 kWh and average flow for total system equaled 29.5 million gallons per day, which equals 10767500000 gallons per year, for average of 0.001563672 kWh/gallon of water required for water treatment. Energy used for water supply is calculated from customer usage figures from Aquarion, which reports 111,200 gallons/residential customer usage in 2007 and 105,000 gallons/residential customer usage in 2010. System-wide, Aquarion reports energy required to supply and distribute water averages 1,200 kWh/million gallons water (=0.0012 kWh/gallon). Combined energy requirement for supply/distribution and treatment is the sum of these two numbers, which equals 0.002763672 kWh/gallon. Electricity savings are calculated based upon water consumption as follows: 2007 water consumption equals 111,200 gallons average/residential customer (Aquarion). 2007 Bridgeport population equals 137,463 in 47543 households (Household number based on Connecticut State Data Center data (Rodriguez, Orlando, 2007. Bridgeport, CT Population Projection from 2010 to 2030 by Age, Ethnicity and Sex Distributions, Connecticut State Data Center, University of Connecticut, Storrs, Connecticut, and assuming linear growth between 2005 and 2010)) for 2.89 persons/household and average consumption of 38,460 gallons/person per year. Forty percent savings for 7,623 households equals 339,058,391 gallons/year (0.4 X 7,623 households X 111,200 gallons/household) or per household savings of 44,480 gallons/year. Savings in 80% of these households equals 271,246,713 gallons/year. Forty percent savings for 8,000 households equals 44,480 gallons/household per year X 8,000 = 355,840,000 gallons. Savings for this action are applied to 80% of the High Growth, for savings of 284,672,000 gallons/year. Note: this Sub Action relies on 2007 consumption figures and per household population figures only, even though Bridgeport's 2010 household consumption data of 105,000 gallons/residential customer (Aquarion) indicates a decline and household population projections also indicate an expected decline from 2007 figure of 2.89 persons/household (from population of 137,463 and 47,543 households (Connecticut State Data Center data (Rodriguez, Orlando, 2007, Bridgeport, CT Population Projection from 2010 to 2030 by Age, Ethnicity and Sex Distributions, Connecticut State Data Center, University of Connecticut, Storrs, Connecticut, and assuming linear growth between 2005 and 2010)) to 2.75 persons/household (from population projection of 151,740 and 55,166 households (Rodriguez, Orlando, 2007; Bridgeport, CT Population Projection from 2010 to 2030 by Age, Ethnicity and Sex Distributions, Connecticut State Data Center, University of Connecticut, Storrs, Connecticut, and assuming linear growth between 2005 and 2010).

[340] Upon recommendation of ICLEI, Bridgeport GHG Inventory conducted for calendar year 2007 used Egrid Subregion 1 – NPCC New England coefficient figures for 2004 as follows: CO2 908.9 lbs/MWH; N20 0.015 lbs/MWH; CH4 0.080 lbs/MWH and criteria air pollutants as follows: NOX 0.677 lbs/MWH; SOX 1.262 lbs/MWH; CO 1.216 lbs/MWH; VOC 0.136 lbs/MWH; PM10 0.982 lbs/MWH. Bridgeport inventory had input of 762,419,176 total kWh community-wide and reported 316,511 $MTCO_2e$ of electricity-related emissions for community-wide average of 0.000415141 $MTCO_2e$/kWh. Electricity emissions savings are calculated based upon this coefficient.

[341] Energy savings recorded here are only for energy required for supply and treatment of water. See the Green Buildings section of this Bridgeport Energy plan for energy and emissions savings related to decreased fuel use resulting from other aspects of Green Building actions.

[342] Low Growth projection of 47,543 households derived from Connecticut State Data Center data (Rodriguez, Orlando, 2007; Bridgeport, CT Population Projection from 2010 to 2030 by Age, Ethnicity and Sex Distributions, Connecticut State Data Center, University of Connecticut, Storrs, Connecticut, and assuming linear growth between 2005 and 2010); additional households for High Growth reflects possible household additions from increased

development predominantly in Bridgeport's urban core, as promoted by Bridgeport Plan of Conservation and Development revised in 2009 and as also enabled by 2009 revisions to Bridgeport's zoning regulations.

[343] Rounding contributes to difference in total.

[344] Greg Kats, Sustainable Building Task Force, "The Cost and Financial Benefits of Green Buildings," October 2003. www.ciwmb.ca.gov/GreenBuilding/Design/CostBenefit/Report.pdf.

[345] Greg Kats, Massachusetts Technology Collaborative, "Green Building Costs and Financial Benefits," 2003, http://www.google.com/search?sourceid=navclient&ie=UTF8&rlz=1T4HPND_en___US236&q=Green+Building+Costs+and+Financial+Benefits.

[346] Energy required to treat water through Bridgeport's water treatment system is calculated from the following: total electricity used by Bridgeport WPCA in 2007 (WPCA for Bridgeport 2007 GHG Inventory input) equaled 16,836,833 kWh and average flow for total system equaled 29.5 million gallons per day, which equals 10,767,500,000 gallons per year, for average of 0.001563672 kWh/gallon of water required for water treatment.

[347] Upon recommendation of ICLEI, Bridgeport GHG Inventory conducted for calendar year 2007 used Egrid Subregion 1 – NPCC New England coefficient figures for 2004 as follows: CO2 908.9 lbs/MWH; N20 0.015 lbs/MWH; CH4 0.080 lbs/MWH and criteria air pollutants as follows: NOX 0.677 lbs/MWH; SOX 1.262 lbs/MWH; CO 1.216 lbs/MWH; VOC 0.136 lbs/MWH; PM10 0.982 lbs/MWH. Bridgeport inventory had input of 762,419,176 total kWh community-wide and reported 316,511 $MTCO_2e$ of electricity-related emissions for community-wide average of 0.000415141 $MTCO_2e$/kWh. Electricity emissions savings are calculated based upon this coefficient.

[348] This action assumes capture and 100% infiltration of 20 inches of precipitation, which is less than 50% of Bridgeport annual average precipitation of 44.15 inches. Calculations are based on the average residential flat roof size of 1,216 square feet (Bridgeport Tax Assessor data): (1,216 square feet) X (144 square inches/square foot) X (20 inches precipitation) = (175,061) X (20) = 3,501,223 cubic inches water. Converting to gallons: (3,501,223 cubic inches water)/231 = 15,156.81 gallons per roof per year under given capture assumptions.

[349] Energy required to treat water through Bridgeport's water treatment system is calculated from the following: total electricity used by Bridgeport WPCA in 2007 (WPCA for Bridgeport 2007 GHG Inventory input) equaled 16,836,833 kWh and average flow for total system equaled 29.5 million gallons per day, which equals 10,767,500,000 gallons per year, for average of 0.001563672 kWh/gallon of water required for water treatment.

[350] Upon recommendation of ICLEI, Bridgeport GHG Inventory conducted for calendar year 2007 used Egrid Subregion 1 – NPCC New England coefficient figures for 2004 as follows: CO2 908.9 lbs/MWH; N20 0.015 lbs/MWH; CH4 0.080 lbs/MWH and criteria air pollutants as follows: NOX 0.677 lbs/MWH; SOX 1.262 lbs/MWH; CO 1.216 lbs/MWH; VOC 0.136 lbs/MWH; PM10 0.982 lbs/MWH. Bridgeport inventory had input of 762,419,176 total kWh community-wide and reported 316,511 $MTCO_2e$ of electricity-related emissions for community-wide average of 0.000415141 $MTCO_2e$/kWh. Electricity emissions savings are calculated based upon this coefficient.

[351] This action assumes capture and 100% infiltration of 20 inches of precipitation, which is less than 50% of Bridgeport annual average precipitation of 44.15 inches. Calculations are based on the average usable residential pitched roof size of 1,248 square feet. Bridgeport Tax Assessor data shows average footprint for pitched roof residential buildings as 1,103 square feet. Surface area of the roof is calculated to reflect greater catchment potential over a flat roof with similar "footprint", but no adjustment is made for varying roofing materials (see Office of the State Engineer, State of New Mexico, Chapter 7 Water Collection, http://www.ose.state.nm.us/water-info/conservation/pdf-manuals/Roof-Reliant-Landscaping/RRL-Chapter-7.pdf).The 1,248 figure used for this Energy Plan represents the combined roof size of both roof sides, which is calculated to be 1,560 square feet based on 1,103 footprint/roofprint, adjusted downward by 20% to reflect rainfall loss from roof shape. (1,248 square feet) X (144 square inches/square foot) X (20 inches precipitation) = (179,712) X (20) = 3,594,240 cubic inches water. Converting to gallons: (3,594,240 cubic inches water)/231 = 15,559 gallons per roof per year under given capture assumptions.

[352] Materials costs of $3-$5 per square foot are noted in Connecticut Department of Environmental Protection, Bureau of Water Resources and Land Reuse, Planning and Standards Division, "Rainfall as a Resource; a Resident's Guide to Rain Gardens in Connecticut," http://www.ct.gov/dep/lib/dep/water/watershed_management/wm_plans/lid/what_is_a_rain_garden.pdf

[353] Labor calculations are detailed in following note.

[354] Labor calculation for flat roof rain garden assumes the following: 8 man days/100 square feet average labor (an average of 4 installers for 2 days is assumed average based on case study information presented in "Rain Garden Costs, Case Studies," Madeline Flahive DiNardo, Agricultural Agent,

Rutgers Cooperative Extension; http://www.water.rutgers.edu/Rain_Gardens/RGWebsite/FlahiveDiNardo_RGCosts.pdf). Required size for rain garden, which is 6 inches deep, equals 185 sq ft based on 1,103 square foot average roof size (from Bridgeport Tax Assessor data) sized to collect precipitation from 1" rain event (contributing roof size/6 is reported as sufficient to collect 1 inch rainfall by UCONN Cooperative Extension, Rain Gardens, http://www.sustainability.uconn.edu/pdf/raingardenbroch.pdf). Calculating: (185 square feet/100 square feet) X (8 man days/100 square feet) = 14.8 man-days/site; this employment estimate assumes 15 man-days per site. Labor calculation for pitched roof residential building is developed based on the same assumptions and average roof size of 1,216 square feet (derived from Bridgeport Tax Assessor data). Labor required for rain garden on pitched roof residential property equals (200 square feet/100 square feet) x (8 man-days per 100 square feet) = 16 man-days.

[355] Energy required to treat water through Bridgeport's water treatment system is calculated from the following: total electricity used by Bridgeport WPCA in 2007 equaled 16,836,833 kWh (figure from WPCA for Bridgeport 2007 GHG Inventory input) and average flow for total system equaled 29.5 million gallons per day, which equals 10,767,500,000 gallons per year, for average of 0.001563672 kWh/gallon of water required for water treatment. This Energy Plan recognizes this single gallon average must be considered a rough figure as many variables impact flow rate, treatment demand and energy demand.

[356] Upon recommendation of ICLEI, Bridgeport GHG Inventory conducted for calendar year 2007 used Egrid Subregion 1 – NPCC New England coefficient figures for 2004 as follows: CO2 908.9 lbs/MWH; N20 0.015 lbs/MWH; CH4 0.080 lbs/MWH and criteria air pollutants as follows: NOX 0.677 lbs/MWH; SOX 1.262 lbs/MWH; CO 1.216 lbs/MWH; VOC 0.136 lbs/MWH; PM10 0.982 lbs/MWH. Bridgeport inventory had input of 762,419,176 total kWh community-wide and reported 316,511 $MTCO_2e$ of electricity-related emissions for community-wide average of 0.000415141 $MTCO_2e$/kWh. Electricity emissions savings are calculated based upon this coefficient.

[357] This assumes a 2,500-gallon collection potential per building per year. Connecticut DEP notes that in the six months from April and September, Connecticut receives 25 inches of rainfall, and that 1 inch of rain on a 1,000 square foot roof yields 623 gallons of water (Pollution Prevention View; Connecticut DEP, Summer 2007; http://www.ct.gov/dep/lib/dep/p2/newsletter/p2viewsummer07.pdf).

The proposed formula: ((Roof size in square feet X 623)/1,000) is used for Bridgeport flat roof residential buildings having average footprint of 1,216 square feet to yield 15,148 gallon collection potential. This Bridgeport Energy plan assumes only a 5% capture of this, however, due to expected loss from too much rain at one time (excess flow that cannot be captured) and incomplete capture during rain events because barrels are already filled. Review of Bridgeport rain events for parts of two growing seasons (June 2009 to October 2009 and March 2010 to May 2010) showed a significant number of successive rain events with greater than ¼ inch of rainfall (the amount required to fill a rain barrel from an average roof), which might result in "non-capture." (Bridgeport precipitation –Weather Underground, http://www.wunderground.com/history/airport/KBDR/2009/6/21/MonthlyHistory.html#calendar).

[358] Energy required to treat water through Bridgeport's water treatment system is calculated from the following: total electricity used by Bridgeport WPCA in 2007 equaled 16,836,833 kWh (figure from WPCA for Bridgeport 2007 GHG Inventory input) and average flow for total system equaled 29.5 million gallons per day, which equals 10,767,500,000 gallons per year, for average of 0.001563672 kWh/gallon of water required for water treatment. This Energy Plan recognizes this single gallon average must be considered a rough figure as many variables impact flow rate, treatment demand and energy demand.

[359] Upon recommendation of ICLEI, Bridgeport GHG Inventory conducted for calendar year 2007 used Egrid Subregion 1 – NPCC New England coefficient figures for 2004 as follows: CO2 908.9 lbs/MWH; N20 0.015 lbs/MWH; CH4 0.080 lbs/MWH and criteria air pollutants as follows: NOX 0.677 lbs/MWH; SOX 1.262 lbs/MWH; CO 1.216 lbs/MWH; VOC 0.136 lbs/MWH; PM10 0.982 lbs/MWH. Bridgeport inventory had input of 762,419,176 total kWh community-wide and reported 316,511 $MTCO_2e$ of electricity-related emissions for community-wide average of 0.000415141 $MTCO_2e$/kWh. Electricity emissions savings are calculated based upon this coefficient.

[360] This assumes a 2,500-gallon collection potential per building per year. Connecticut DEP notes that in the six months from April and September, Connecticut receives 25 inches of rainfall, and that 1 inch of rain on a 1,000 square foot roof yields 623 gallons of water (Pollution Prevention View; Connecticut DEP, Summer 2007; http://www.ct.gov/dep/lib/dep/p2/newsletter/p2viewsummer07.pdf). The proposed formula: ((Roof size in square feet X 623)/1,000) is used for Bridgeport pitched roof residential buildings having average footprint of 1,103 square feet to yield 13,743 gallon collection potential. This Bridgeport Energy plan assumes only a 5% capture of this, however, due to expected loss from too much rain at one time (excess flow that cannot be captured) and incomplete capture during rain events because barrels are already filled.

[361] Bridgeport existing flat roof residential buildings equals 934 and Bridgeport existing pitched roof residential buildings equals 21,932 (Bridgeport Tax Assessor data).

[362] Labor estimate assumes the following: 0.5 man-day per barrel installation for hook up and barrel and rain leader modification (or new installation).

[363] Energy required to treat water through Bridgeport's water treatment system is calculated from the following: total electricity used by Bridgeport WPCA in 2007 equaled 16,836,833 kWh (figure from WPCA for Bridgeport 2007 GHG Inventory input) and average flow for total system equaled 29.5 million gallons per day, which equals 10,767,500,000 gallons per year, for average of 0.001563672 kWh/gallon of water required for water treatment. This Energy Plan recognizes this single gallon average must be considered a rough figure as many variables impact flow rate, treatment demand and energy demand.

[364] Upon recommendation of ICLEI, Bridgeport GHG Inventory conducted for calendar year 2007 used Egrid Subregion 1 – NPCC New England coefficient figures for 2004 as follows: CO2 908.9 lbs/MWH; N20 0.015 lbs/MWH; CH4 0.080 lbs/MWH and criteria air pollutants as follows: NOX 0.677 lbs/MWH; SOX 1.262 lbs/MWH; CO 1.216 lbs/MWH; VOC 0.136 lbs/MWH; PM10 0.982 lbs/MWH. Bridgeport inventory had input of 762,419,176 total kWh community-wide and reported 316,511 $MTCO_2e$ of electricity-related emissions for community-wide average of 0.000415141 $MTCO_2e$/kWh. Electricity emissions savings are calculated based upon this coefficient.

[365] Potential for water capture by green roofs and deferral from Bridgeport water treatment facility is developed based upon full capture of 20 inches of rain from a single flat roof commercial building but then only includes 65% of water volume to reflect the fact that a certain volume of water may be detained but not retained and that certain roof space may be set aside for other purposes such as heating and cooling equipment or possibly solar pv systems. Annual precipitation in Bridgeport is more than double the 20-inch capture figure upon which calculation is made, but it is believed the 20-inch figure better accounts for loss due to events during which precipitation exceeds green roof retention capacity. Modeling studies of Washington D.C. green roof potential report 80% extensive/20% intensive green roof materials can reduce water discharge by 69%, and also report significant beneficial impact to reducing rate of runoff from roofs and CSO's, even at 20% total potential coverage (Deutsch, Barbara et.al., Casey Trees Endowment Fund and Limno-Tech, Inc., 2005, Re-Greening Washington D.C.: A Green Roof Vision Based on Quantifying Storm Water and Air Quality Benefit). Specific to Bridgeport, 1,531 existing commercial flat roof buildings have a combined footprint equal to 14,843,484 square feet, for an average of 9,695 square feet/building (Bridgeport Tax Assessor data). Twenty inches of precipitation on an average 9,695 square foot roof is calculated as follows: (roof size in square feet) X (144 inches/square foot) X 20 inches = cubic inches of water, which is then divided by 231 to yield volume of water in gallons. ((9,695 square feet)X(144 inches/square feet) X (20 inches precipitation))/231 = 27,922,426/231 = 120,876 gallons of water from 20 inches of precipitation per year per average size (footprint) commercial building. Assuming 65% rate of capture that leads to complete deferral from water treatment, the volume of water deferred per building equals 78,570 gallons/building per year.

[366] Existing flat roof commercial building number equals 1,531(Bridgeport Tax Assessor data). 460 buildings equal 30% of existing flat-roof commercial buildings. 2007 flat roof living area equals 76% of total commercial living area (flat plus non-flat) (Bridgeport Tax Assessor data). For Low Growth scenario, assume 14,916 total job increase is split as 500 industrial jobs and 14,416 commercial jobs. Square footage increase is calculated using 1.5 employee/1000 square feet for industrial jobs and 4 employees/1000 square feet for commercial jobs. Increased commercial square footage divided by Bridgeport average commercial/industrial living space of 17,046 square feet (Bridgeport Tax Assessor data) yields 231 new commercial buildings projected 2007-2030 under Low Growth scenario. Assume 76% of new buildings are flat-roof, so new flat roof C/I building number equals 175 for Low Growth scenario. Similar calculations yield additional C/I building increase of 195 total buildings under High Growth scenario, based on 27,500 total projected job increase and assumed split of 922 industrial/26,578 commercial jobs. Assume 76% of 195 additional commercial buildings under High Growth scenario are flat roof, yielding 148 additional new flat roof CI buildings. Green roofs proposed for 30% of new buildings under Low Growth and High Growth scenarios.

[367] Barbara Deutsch, et. al, Casey Trees Endowment Fund and Limno-Tech, Inc., Re-Greening Washington, D.C.: A Green Roof Vision Based on Quantifying Storm Water and Air Quality Benefits, 8/24/05, http://www.greenroofs.org/resources/greenroofvisionfordc.pdf

[368] Washington D.C. green roof subsidy program: D.C. Greenworks; http://www.dcgreenworks.org/index.php?option=com_content&task=view&id=72

[369] Energy required to treat water through Bridgeport's water treatment system is calculated from the following: total electricity used by Bridgeport WPCA in 2007 equaled 16,836,833 kWh (figure from WPCA for Bridgeport 2007 GHG Inventory input) and average flow for total system equaled 29.5 million gallons per day, which equals 10,767,500,000 gallons per year, for average of 0.001563672 kWh/gallon of water required for water treatment. This Energy Plan recognizes this single gallon average must be considered a rough figure as many variables impact flow rate, treatment demand and energy demand.

[370] Upon recommendation of ICLEI, Bridgeport GHG Inventory conducted for calendar year 2007 used Egrid Subregion 1 – NPCC New England coefficient figures for 2004 as follows: CO2 908.9 lbs/MWH; N20 0.015 lbs/MWH; CH4 0.080 lbs/MWH and criteria air pollutants as follows: NOX 0.677 lbs/MWH;

SOX 1.262 lbs/MWH; CO 1.216 lbs/MWH; VOC 0.136 lbs/MWH; PM10 0.982 lbs/MWH. Bridgeport inventory had input of 762,419,176 total kWh community-wide and reported 316,511 $MTCO_2e$ of electricity-related emissions for community-wide average of 0.000415141 $MTCO_2e$/kWh. Electricity emissions savings are calculated based upon this coefficient.

[371] Potential for water detention and deferral from Bridgeport water treatment facility is developed based upon full capture of 20 inches of rain from a single flat roof commercial building. Annual precipitation in Bridgeport is more than double the 20-inch capture figure upon which calculation is made, but it is believed the 20-inch figure better accounts for loss due to events during which precipitation exceeds detention/retention capacity. In Bridgeport, 1,531 existing commercial flat roof buildings have a combined footprint equal to 14,843,484 square feet, for an average of 9,695 square feet/building (Bridgeport Tax Assessor data). Twenty inches of precipitation on an average 9,695 square foot roof is calculated as follows: (roof size in square feet) X (144 inches/square foot) X 20 inches = cubic inches of water, which is then divided by 231 to yield volume of water in gallons. ((9,695 square feet) X(144 inches/square feet) X (20 inches precipitation))/231 = 27,922,426/231 = 120,876 gallons of water from 20 inches of precipitation per year per average size (footprint) commercial building.

[372] Potential for water detention and deferral from Bridgeport water treatment facility is developed based upon full capture of 20 inches of rain from a single pitched roof commercial building. Annual precipitation in Bridgeport is more than double the 20-inch capture figure upon which calculation is made, but it is believed the 20-inch figure better accounts for loss due to events during which precipitation exceeds detention/retention capacity. In Bridgeport, 915 existing commercial flat roof buildings have a combined footprint equal to 5,526,364 square feet for an average of 6,040 square feet/building (Bridgeport Tax Assessor data). Pitched roof "roof print"/surface area is calculated from footprint, assuming 45-degree pitch to yield commercial pitched roof average footprint for 1 side of roof equal to 4,269. Commercial pitched roof average roof footprint 2 sides (not basement) square feet equals 8,540, but this Energy Plan assumes additional 20% loss to account for non-capture related to roof shape/overhang, etc., to yield 6,832 square feet average. Twenty inches of precipitation on an average 6,832 square foot roof is calculated as follows: (roof size in square feet) X (144 inches/square foot) X 20 inches = cubic inches of water, which is then divided by 231 to yield volume of water in gallons. ((6,832 square feet) X(144 inches/square feet) X (20 inches precipitation))/231 = 19,676,160/231 = 85,178 gallons of water from 20 inches of precipitation per year per average size (footprint) commercial building

[373] Building count from Bridgeport Tax Assessor data.

[374] This estimate assumes 6 inch depth.

[375] Labor estimate assumes the following: the average footprint of a flat roof commercial building in Bridgeport equals 9,695 square feet (calculated from Tax Assessor data). The capture area required for a 1 inch rainfall equals square foot contributing roof area/6 (formula from UCONN Cooperative Extension, Rain Gardens, http://www.sustainability.uconn.edu/pdf/raingardenbroch.pdf). Calculating, the required detention area for 1 building equals1, 600 square feet. 8 man days/100 square feet average labor is assumed labor (an average of 4 installers for 2 days is assumed average based on case study information presented in Rain Garden Costs, Case Studies, Madeline Flahive DiNardo, Agricultural Agent, Rutgers Cooperative Extension;

http://www.water.rutgers.edu/Rain_Gardens/RGWebsite/FlahiveDiNardo_RGCosts.pdf). Calculating 8 man-days/100 square feet for 9,695 square feet equals 128 man-days per site.

[376] Labor estimate assumes the following: the average footprint of a flat roof commercial building in Bridgeport equals 6,039 square feet (calculated from Tax Assessor data). The capture area required for a 1 inch rainfall equals square foot contributing roof area/6 (formula from UCONN Cooperative Extension, Rain Gardens, http://www.sustainability.uconn.edu/pdf/raingardenbroch.pdf). Calculating, the required detention area for 1 building equals 1,000 square feet. 8 man days/100 square feet average labor is assumed labor (an average of 4 installers for 2 days is assumed average based on case study information presented in Rain Garden Costs, Case Studies, Madeline Flahive DiNardo, Agricultural Agent, Rutgers Cooperative Extension;

http://www.water.rutgers.edu/Rain_Gardens/RGWebsite/FlahiveDiNardo_RGCosts.pdf). Calculating 8 man-days/100 square feet for 1,000square feet equals 80 man-days per site.

[377] The City of Bridgeport has installed permeable paving materials at the Beardsley Zoo and Fairchild Wheeler golf course.

[378] This action assumes the creation of a 4-to-6-foot wide vegetative buffer on 5% of City's roadways, or 9.29 miles of roadway (derived from ConnDot data supplied for Bridgeport 2007 GHG inventory; local, "City-controlled" roadway total equals 185.8 miles). This action assumes creation of a vegetative swale 6 inches deep on one side of the street only, or situated as a central swale, and assumes a 50-foot wide street. Water capture requirement is calculated as follows: total street surface area of 9.29 miles of roadway, which is 50 feet wide = (50 feet) X (5,280 feet/mile) X (9.29 miles) = 2,452,560

square feet. Water volume from ½ inch rain falling on given street surface equals (2,452,560 square feet) X (144 inches/square foot) X (0.5 inch) = 176,584,320 cubic inches water. Conversion to gallons: (176,584,320 cubic inches)/231 = 764,434 gallons water. Swale width required to collect an equal volume of water is calculated as follows, assuming swale is 6 inches deep: (surface area of roadway accepting precipitation) / (6 inch swale depth/1/2 inch precipitation) = (2,452,560)/(12) = 204,380 square feet of space required having 6 inch depth. Determining swale width: (Square feet of potential bioswale space)/(length of swale) = (204,380 square feet)/(9.29 miles X 5,280 feet/mile) = 4.1666 feet. A 4.17-foot wide swale in front of 20 houses with 1,000 lineal feet frontage combined, would provide the effective benefit of collecting 623,336 gallons of water. Slightly more than 49 sections of 1,000 lineal feet (40.0512) are required, but this length decreases as swale width increases. This Bridgeport Energy Plan assumes 20 inches of precipitation is the cumulative total of forty ½ inch rain events.

This action assumes savings based on cumulative saving of forty 1/2inch precipitation events, for a total of 20 inches of precipitation per year. This is less than half total average annual precipitation, which equals 44.15 inches per year. This Bridgeport Energy Plan assumes certain rain events will exceed capacity of bioswales associated with complete streets to accept all water, but that all water accepted will benefit water treatment facilities' capability to manage water capacity and reduce incidences of stormwater overflows.

[379] 49 units (groups of 20 households with combined total of 1,000 lineal feet street frontage) fall slightly short of goal due to rounding impact associated with decimal placement; 50 exceed it.

[380] The EPA, National Association of Clean Water Agencies, Natural Resources Defense Council, the Low Impact Development Center, and the Association of State and Interstate Water Pollution Control Administrators have formalized a collaborative effort to "promote the benefits of using green infrastructure in protecting drinking water supplies and public health, mitigating overflows from combined and separate sewers and reducing stormwater pollution, and to encourage the use of green infrastructure by cities and wastewater treatment plants as a prominent component of their Combined and Separate Sewer Overflow (CSO & SSO) and municipal stormwater (MS4) programs". (U.S. Environmental Protection Agency, American Rivers, Association of State and Interstate Water Pollution Control Administrators, National Association of Clean Water Agencies, Natural Resources Defense Council, The Low Impact Development Center, *Managing Wet Weather With Green Infrastructure, Action Strategy 2008*, http://www.epa.gov/npdes/pubs/gi_action_strategy.pdf).