



**Tracking GHG Emissions and Goals for Hartford, CT:
A Methodology**

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Table of Contents

PURPOSE OF DOCUMENT	4
PROTOCOL COMPLIANCE	6
LOCAL GOVERNMENT OPERATIONS PROTOCOL (LGOP).....	6
GLOBAL PROTOCOL FOR COMMUNITY-SCALE GHG EMISSIONS (GPC).....	6
PROTOCOL PRINCIPLES	7
INVENTORY BOUNDARY CONDITIONS	9
GEOGRAPHIC BOUNDARY	9
TIME BOUNDARY: BASELINE YEAR	11
OPERATIONAL BOUNDARY.....	11
<i>Types of Greenhouse Gases</i>	13
<i>Required Data</i>	13
<i>Renewable Energy</i>	15
TOOL SETUP AND PREPARATION	15
THE TOOL REQUIRES:	15
SETUP STEPS:	15
DATA REQUIREMENTS	15
CONTROL SHEET	16
ENTRY SHEETS AND DATA SHEETS	17
SOLID WASTE.....	17
WASTEWATER.....	18
MOBILE COMBUSTION	19
ELECTRICITY.....	20
STATIONARY COMBUSTION.....	21
TOOL ANALYSIS AND ADDITIONAL DATA TABS	21
ADDITIONAL EMISSION SOURCES	21
SUMMARY- EMISSIONS	22
FACTORS.....	22
DATA MANAGEMENT	22
ACTIVITY DATA.....	22
DATA MANAGEMENT	23
GOAL TRACKING MANAGEMENT.....	23
DATA COLLECTION PROCESS – NORMALIZATION FACTOR	24
DATA COLLECTION PROCESS – QUALITY ASSURANCE	24
FREQUENCY	24
BASE YEAR	25
ADJUSTMENT – RECALCULATING EMISSIONS	25
AUDITING AND VERIFICATION	26
INTERNAL AUDITING.....	26
EXTERNAL VALIDATION AND/OR VERIFICATION	26



MANAGEMENT REVIEW	26
CORRECTIVE ACTION	26
REFERENCES.....	27
APPENDIX.....	27

Purpose of Document

The City of Hartford is committed to reducing energy consumption and becoming a more sustainable community. The city demonstrated this commitment by pledging as part of the Clean Energy Communities (a State program) funded by Clean Energy Finance and Investment Authority (CEFIA) and the Connecticut Energy Efficiency Fund. This pledge imposes obligations to benchmark building energy use and commit to reduction targets, as well as targets to purchase a certain amount of clean energy. Additional details on City of Hartford’s pledge can be found in the Hartford Pledge Document in the Appendix but a few of the goals are as follows:

1. The city of Hartford pledges to reduce its municipal building energy consumption by 20% by 2018. Building energy consumption shall be determined by benchmarking municipal building energy consumption to a baseline year.
2. The city of Hartford will work with the Companies, Contractors or other entities to benchmark all of its municipal buildings (including board of education buildings) to determine all municipal building energy usage.
3. Beginning July 1, 2015, the City of Hartford agrees to provide documentation of its municipal building energy consumption on an annual basis by the end of the first quarter of the following year.
4. The City of Hartford pledges to create its own Municipal Action Plan (MAP) to determine its path in reducing its energy consumption. The City of Hartford may satisfy this requirement by submitting a pre- existing municipal energy plan, sustainability plan, climate change action plan or similar document.

In addition, the U.S. Conference of Mayors has signed on along with 1,060 local governments to commit to meet GHG reduction targets and to encourage national leaders to adopt federal climate change policies (U.S. Conference of Mayors, 2015). Hartford, CT is one of these 1060 cities, agreeing to reduce carbon emissions to below 1990 levels, in line with Kyoto Protocol. View full agreement here:

<http://www.usmayors.org/climateprotection/ClimateChange.asp>

Some of the goals under this agreement include:

- Inventory Global warming emissions in City operations and in the community, set reduction targets and create an action plan.



- Make energy efficiency a priority through building code improvements, retrofitting city facilities with energy efficient lighting and urging employees to conserve energy and save money;

To meet the first of these goals– Hartford needs to understand and track community-wide emissions by developing an inventory of emissions from each of their sources. This document contains a repeatable and consistent methodology that can be followed each year to collect and track the emissions inventory for government operations. Once a goal is set, emissions must be tracked consistently in order to compare reductions accurately over time. This methodology was originally developed in August 2016, and is specific to the current data availability and energy sources of the City of Hartford at this time.

Creating an emissions inventory requires making decisions about what to include and how to collect and calculate emissions data. This document explains these decisions and describes the methodology for collecting and calculating the data by using the EPA Local GHG Inventory Tool. It is meant as a living file and should be updated as changes occur. Using this document and the accompanying Excel Tool (EPA Local GHG Inventory TOOL_August2016.xls), any City employee or city stakeholder is able to recreate the emissions calculation. This document is a repository for all information relevant to the GHG inventory calculations. By calculating emissions annually, the City can track progress towards its GHG reduction goal.

TOOL

Local government commonly uses two types of inventories, a Community wide inventory and a Government operations inventory. The government operations inventory module fits into the local community wide inventory. This document has some community wide inventory example methodologies for comparison however is primarily focused on conducting a Scope 1 and Scope 2 GHG emissions inventory for Government Operations. Local government operations typically comprise between 3% to 8% of community wide emissions. To set a strong example for its citizens, the City of Hartford can begin GHG tracking and management by conducting a GHG inventory for government operations. This will also help the City, track GHG emissions and energy spend, set realistic and trackable reduction targets and goals and strategies an effective municipal CAP. (Climate Action Plan).

The U.S. EPA State and Local Branch have provided guidance and technical support to local governments on their greenhouse gas (GHG) emission inventories since 1990. EPA has leveraged this expertise at the state-level to develop the Local GHG Inventory Tool, to facilitate development of GHG inventories at the local level in a cost effective, easy to implement and transparent manner. Analyzing these emission levels for government operations provides a baseline for tracking emission trends, developing mitigation strategies and policies, and assessing progress towards meeting goals. The Local GHG Inventory tool is comprised of two Excel-based modules: One module helps users develop a baseline GHG of municipal operations, according to the Local Government Operations



Protocol (LGOP), version 1.1; the other helps users develop a baseline GHG inventory according to the Global Protocol for Community-Scale GHG Emissions (GPC).

The target audience for the Local Tool is smaller governments and localities that want to do a relatively simple calculation of GHG emissions, and do not need the detailed in-depth analysis that might come with other options. As such The City of Hartford, CT is an ideal candidate, having never conducting a GHG analysis before and having limited data history.

Please note: The tool does not include the following:

- Emission estimates for multiple years at a time
- Emission projections
- Scenario Planning
- Life-cycle analysis
- Benchmarking analysis

Protocol Compliance

The Local GHG Inventory tool is comprised of two Excel-based modules: One module helps Users to develop a baseline GHG inventory of municipal operations, according to the Local Government Operations Protocol (LGOP), version 1.1; the other module focused at helping users develop a baseline GHG inventory according to the Global Protocol for Community-Scale GHG Emissions (GPC). The Local Greenhouse Gas Inventory Tool modules are organized by scope and source of GHG emissions.

Local Government Operations Protocol (LGOP)

Air Resource Board (ARB) has partnered with the Climate Action Reserve (CAR), The Climate Registry (TCR), and Local Governments for Sustainability (ICLEI) to provide the Local Government Operations Protocol (LGOP) for GHG analysis. The LGOP is a reporting protocol (i.e. a set of common standards and calculation tools for estimating and reporting GHG emissions).

More on it can be found here:

http://www.arb.ca.gov/cc/protocols/localgov/pubs/lgo_protocol_v1_1_2010-05-03.pdf

Global Protocol for Community-Scale GHG Emissions (GPC)

This protocol is prepared by: C40 Cities Climate Leadership Group and ICLEI Local Governments for Sustainability in collaboration with: World Resources Institute, World Bank, UNEP, and UN-HABITAT. The primary goal of this protocol is to provide a standardized step-by-step approach to help cities quantify their GHG emissions in order to manage and reduce their GHG impacts.

More on this protocol can be found here:

http://www.ghgprotocol.org/files/ghgp/GPC_PilotVersion_1.0_May2012_20120514.pdf



Protocol Principles

Both Local Government Operations Protocol (LGOP) and Global Protocol for Community-Scale GHG Emissions (GPC) have adopted the same five overarching principles enumerated below.

Relevance: The greenhouse gas inventory should appropriately reflect the greenhouse gas emissions of the local government and should be organized to reflect the areas over which local governments exert control and hold responsibility in order to serve the decision-making needs of users.

Completeness: All greenhouse gas emission sources and emissions-causing activities within the chosen inventory boundary should be accounted for. Any specific exclusion should be justified and disclosed.

Consistency: Consistent methodologies should be used in the identification of boundaries, analysis of data and quantification of emissions to enable meaningful trend analysis over time, demonstration of reductions, and comparisons of emissions. Any changes to the data, inventory boundary, methods, or any relevant factors in subsequent inventories should be disclosed.

Transparency: All relevant issues should be addressed and documented in a factual and coherent manner to provide a trail for future review and replication. All relevant data sources and assumptions should be disclosed, along with specific descriptions of methodologies and data sources used.

Accuracy: The quantification of greenhouse gas emissions should not be systematically over or under the actual emissions. Accuracy should be sufficient to enable users to make decisions with reasonable assurance as to the integrity of the reported information.

In addition, the methodology must:

1. Meet Hartford's objective to track GHG emissions,
2. Must be transparent and repeatable; simple enough to use, but complex enough to include relevant sources,
3. Must be standardized and widely used.

The table below is adapted from GPC and shows some information about the two protocols that were most applicable to Hartford's government-operations inventory.



Protocol Comparison

Protocol	Author	Target audience	Consistency with major IPCC emission sources categories	Other information	Relevant to Hartford?
Global Protocol for Community- Scale GHG Emissions Inventories (GPC)	C40 ICLEI WRI (2014)	Communities worldwide	Yes	Divides in-boundary and transboundary emissions into scopes 1, 2, and 3 Pilot tested by 35 pilot cities (released in Dec 2014)	Yes
<u>Local Government Operations Protocol (LGOP)</u>	ICLEI USA (2012)	Cities and communities in the U.S.	No ⁶	US specific, more regional focus, many US cities are using. Provides various reporting frameworks including the Five Basic Emissions Generating Activities, local gov't significant influence, comm.-wide activities, household consumption, in-boundary sources, government consumption, full consumption- based inventory, life cycle emissions of comm. businesses, and individual industry sectors.	Yes

Source: Adapted and added to from GPC



Inventory Boundary Conditions

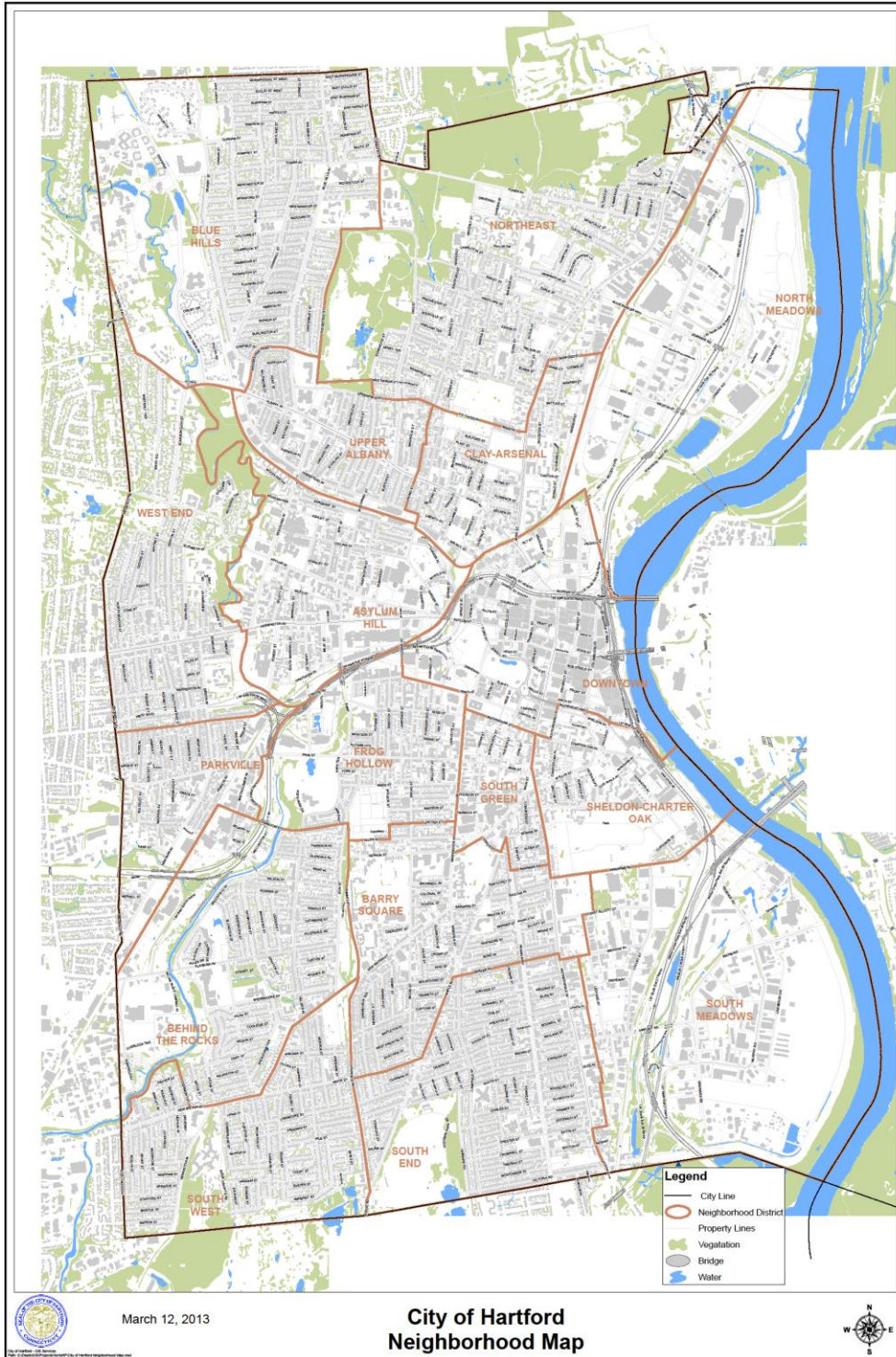
Geographic Boundary

Based on data availability and common practices within the city, the most logical geographic boundary to use for the GHG inventory is the city limits boundary. This boundary can be seen on a map in the City of Hartford 2013 Neighborhood Map on the Hartford.gov Geographical Information Systems webpage

<http://gis1.hartford.gov/Documents/City%20of%20Hartford%20Neighborhood%20Map.pdf>.

This type of inventory is therefore considered a community-wide inventory, meaning that it includes residential and commercial as well as municipal government operations. Alternately an inventory only including Governmental Operations buildings and activities can also be conducted within the Geographical boundaries of the City of Hartford as per the same map. This methodology is specifically written catering to a government operations inventory. However similar applications would be used for a community wide inventory.





Source:
<http://gis1.hartford.gov/Documents/City%20of%20Hartford%20Neighborhood%20Map.pdf>



Time Boundary: Baseline Year

The GHG Inventory requires the choice of an inventory baseline year. Communities may select the most recent year wherein comprehensive, consistent and reliable data may be available. It is suggested that the year be a typical one and not one that had unusual weather conditions, extreme high or low economic growth/activity or any other outlying situation that be change the data significantly. Other considerations may be neighboring or similar cities baseline years to provide a strong benchmark comparison.

The City of Hartford’s GHG Inventory should be calculated for a calendar year from January – December ideally 2014. This is the recommendation as this year is relatively recent, of typical weather and economic conditions.

Operational Boundary

The operational boundary section discusses the specific emission sources that are included within the geographic and time boundary. For effective and innovative GHG management, setting operational boundaries that are comprehensive with respect to direct and indirect emissions will help Hartford better manage the full spectrum of GHG risks and opportunities that exist in its upstream and downstream city and community operations.

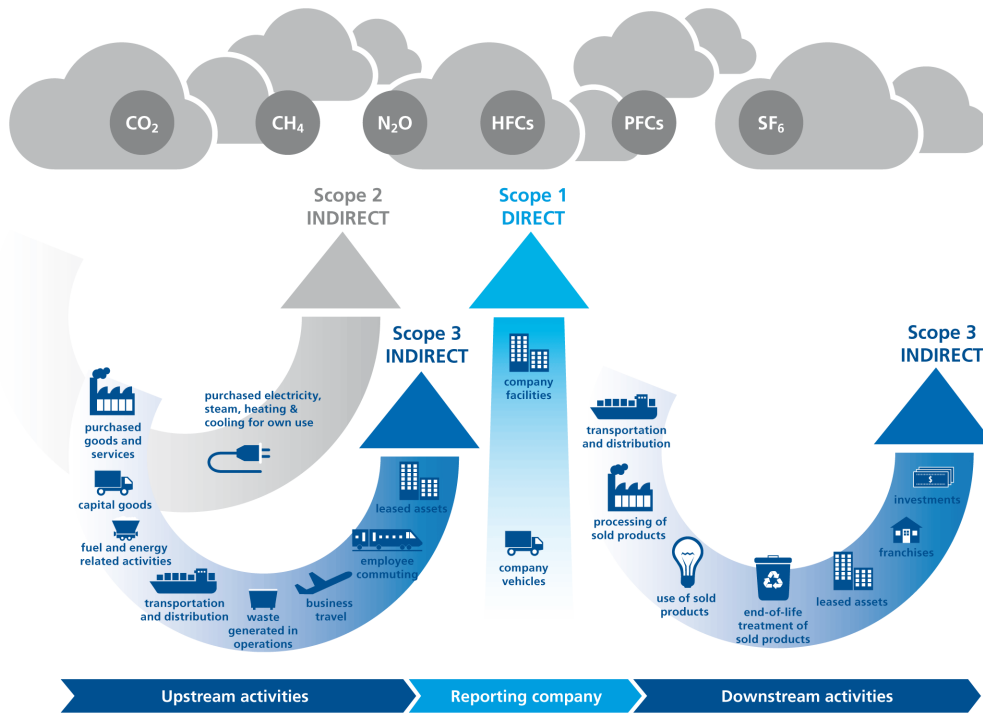
Within each sector there are subsectors. Emissions within each subsector are broken down into scope 1 (occurring within the city boundary), scope 2 (grid-supplied electricity, heat, steam and/or cooling within the city boundary) and scope 3 (occurring outside the city boundary as a result of activities taking place within the city boundary).

Scopes and Sources to be Included in the Government Module of the LGGIT

SCOPES	Sources in Government Module
Scope 1	Stationary Combustion
	Mobile Combustion
	Solid Waste
	Wastewater
Scope 2	Electricity Use
Scope 3	Employee Commute
	Agriculture & Land Management
	Urban Forestry
	Waste Generation
	Water Use
Scope 1,2,3	Additional Emission Sources



Overview of GHG Protocol scopes and emissions across the value chain



Source: myclimate.org - World Resources Institute & World Business Council for Sustainable Development, 2011.

COMPARE:

Scopes and Sources Included in the Community Module of the LGGIT

SCOPES	Sources in LGGIT
Scope 1	Stationary Combustion
	Mobile Combustion
	Solid Waste
	Wastewater
	Electricity Use
Scope 2	Agriculture & Land Management
	Urban Forestry
	Waste Generation
	Water Use
Scope 3	Additional Emission Sources



Types of Greenhouse Gases

As per the Local Government Operations Protocol (LGOP) local governments should assess emissions of all six internationally-recognized greenhouse gases regulated under the Kyoto Protocol. These are:

- Carbon dioxide (CO₂);
- Methane (CH₄);
- Nitrous oxide (N₂O);
- Hydrofluorocarbons (HFCs);
- Perfluorocarbons (PFCs); and
- Sulfur hexafluoride (SF₆)

Hartford has the option of reporting on additional gases as well however methodologies for inventorying these gases may not be easily available through standard reporting protocols.

Most fossil fuel combustion releases CO₂, CH₄ and N₂O. HFCs are commonly found in refrigerants but the effort-to-reward ratio for collecting data on HFCs may be too high at Hartford at this time.

Required Data

Required Data Inputs for the Local Government Greenhouse Gas Inventory Tool

GHG SECTORS	INPUT DATA	
Stationary Combustion of Fossil Fuels (i.e., fuel use at city facilities)	Stationary fuel use (by fuel type)	Scope 1
Electricity Consumption	Electricity consumed (kWh)	Scope 1
	Electric utility	Scope 1
Mobile Combustion of Fossil Fuels (i.e., fuel use by city fleet)	Fuel consumed (by fuel type) (gallons or G.G.E.)	Scope 1
	Vehicle Miles Traveled (miles)	
	Vehicle Model Year	
	Vehicle Type	
Solid Waste Management	City Landfills (number)	Scope 1



	Landfill Gas Collected (MMSCF/yr)	
	Fraction of CH ₄ in landfill gas	
	Landfill Gas Collection Area (fraction)	
Wastewater Treatment	Wastewater treatment process details (aerobic, anaerobic, nitrification, denitrification)	Scope 1
	Population served by wastewater treatment system(s) (people)	
	Population served by septic systems (people)	
	Digester gas produced daily (ft ³ /day)	
	Fraction of CH ₄ in biogas	
	System BOD ₅ load/influent (kg BOD ₅ /day)	
	Fraction BOD ₅ removed in primary treatment	
	Industrial Nitrogen load (kg N/day)	
	Average total Nitrogen discharged (kg N/day)	
Employee Commute	Number of employees (people)	Scope 3
	Employees who use each mode of transit (%)	
	Average one-way commute length (miles)	
	Work days per year (days/yr)	
Agriculture & Land Management	Synthetic fertilizer use (short tons N)	Scope 3
	Organic fertilizer use (short tons)	
	Manure fertilizer use (short tons)	
Urban Forestry	Total urban area (km ²)	Scope 3
	Urban area with tree cover (%)	
Waste Generation	Waste emissions (MTCO _{2e} from EPA's Waste Reduction Model)	Scope 3
	Department contribution to total waste (%)	
Water Use	Percentage of imported water (%)	Scope 3
	Water use (gallons)	
Additional Emission Sources	GHG emissions from each additional source, by gas (MT CO _{2e})	Scope 3



Renewable Energy

As of August 2016 the City of Hartford does not purchase Renewable Energy Certificates (RECs). At any future date if Hartford does begin purchasing RECs to offset their energy use, it should not be deducted from the Scope 2 emissions because doing so would result in double counting. More information can be found in Section 6.2.4 of the Local Government Operations Protocol (LGOP).

Tool Setup and Preparation

The local Greenhouse Gas Inventory tool can be found on the EPA website (<https://www.epa.gov/statelocalclimate/documents-local-greenhouse-gas-inventory-tool>) or by contacting Andrea Denny, Local Climate and Energy Team Lead at the EPA at Denny.Andrea@epa.gov. I recommend downloading the Excel file as well as the User Guide which provides generic tool setup support and guidance.

The Tool requires:

- IBM-PC compatible computer with the Windows XP operating system or later;
- Microsoft® Excel 2007 or later, with calculation set to automatic and macros enabled;
- Hard drive with at least 20MB free; and
- Monitor display setting of 800 x 600 or greater

Setup Steps:

- Once the tool has been opened, Excel must be set to 'automatic calculations' in the formula ribbon.
- 'Macros' should be enabled within the security settings of excel.
- These settings will keep resetting to default each time the tool is closed, so remember to re-select each time the tool is reopened.

Data Requirements

The Government Module is setup to allow any level of data granularity in order to be flexible to the needs and specifications of each municipalities. Data can be entered at any scale, ranging from city-wide activity data to data by facility or even each meter. The more specific the data provided by the user, the better. At this point due to the level of detail in the data available for Hartford it is best to conduct a city wide emission analysis.



Control Sheet

The control sheet at the very start of the analysis and its purpose is to setup the tool specific to The city of Hartford's identity. It includes a 5 step questionnaire and once complete will customize the tool the accept the data you will provide.

Information to be provided on this sheet includes

- Name of Municipality and its population for the year the inventory is being conducted.
- Specific inventory Year.
- The number of departments information to be entered. For example: For Hartford using City wide data we enter '1' department named 'City'.
- EGrid sub region of the municipality. For Hartford: NEWE eGRID subregion.

Inventory Control Sheet

[Return to Table of Contents](#)

Complete the 5 steps below to set up the tool for your municipality.

Please enter the name of your city, the inventory year, and the population below.

Municipality	<input type="text" value="City of Hartford"/>	
Year	<input type="text" value="2015"/>	<input type="button" value="▲"/>
Population	<input type="text" value="120,000"/>	<input type="button" value="▼"/>

Please specify the number of departments in your city by using the button to the right of the input cell below.

You should configure the departments based on the type of data you have available and at what scale. Departments do not need to correspond to every department within the municipality, but should be set up to reflect organizational units for which the most comprehensive data is available. For example, if you have City-wide data, you may set up only one department, "City." Alternatively, if you have data broken down by billing units which are different from city departments, you may name the "Departments" after those units. You must enter a minimum of 1 department in this step.

The maximum number of departments is 20. The minimum is 1.

<input type="text" value="1"/>	<input type="button" value="▲"/>
	<input type="button" value="▼"/>

Next, please enter the names of each department here.

1	<input type="text" value="City"/>
---	-----------------------------------

Select the eGRID subregion where your community is located and enter up to 5 utility-specific emissions factors, if available, for the utilities that provide electric service for your municipal operations.

These utility selections and emission factors will be used to help calculate your municipal emissions throughout the tool.

Please see the map below the table to identify the eGRID subregion that includes your community and continue to Step 5 below once this task is complete.

Select eGRID Subregion...	Emission Factors (lb/MWh)			Total EF
	CO ₂	CH ₄	N ₂ O	lb CO ₂ e/MWh
Select your subregion: NEWE eGRID subregion	637.90	0.073	0.011	642.91

Once this information has been entered click 'Set Up' and 'Check if you have completed this sheet'. This will set up each consequent sheet based on the information you provided thus configuring the tool to Hartford's municipality.

Note: The Control Sheet must be filled out in the beginning or else the tool will not work effectively.



Setting up a base year for GHG emissions reporting progress over time is necessary that which future year to develop a base track emission file are saved. The selection of several factors base year caused economic conditions city has under larger state, national. The Local Government online at: <http://www.cityofhartford.com>

Entry Sheets and Data Sheets

Each category of data has two types of sheets; Entry Sheets and Data Sheets. Entry Sheets are where the data for that category is entered based on questions presented. The level of granularity of the question will depend on the choices made in the Control Sheet section. Therefore, the control sheet must be completed, set up and saved before Entry sheets and Data Sheets are used. When each Entry Sheet is complete, the Data entered on the Entry Sheets appear on the Data Sheets.

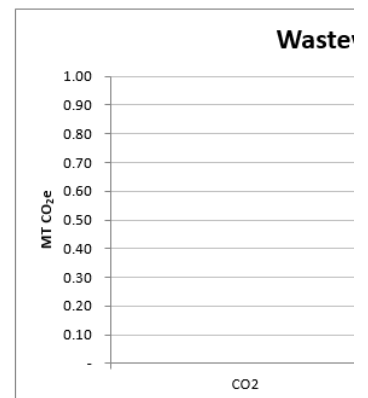
Data Sheets typically provide a summary and analysis of the data entered.

Wastewater - Calculation & Summary

This sheet shows the formulas used to determine your city's emissions from wastewater treatment, using methodology from the Local Government Operations Protocol (2010). The yellow cells link to the values you entered on the previous sheet, "Wastewater-Entry."

Your total emissions are summarized in the table below. You may scroll down to view the detailed calculations, but **no action is required on this sheet**. If you would like to change any of the entered values, you may do so on the previous sheet.

GHG Emissions Summary	
	MT CO ₂ e
CO ₂	-
CH ₄	-
N ₂ O	-
Total Emissions from Wastewater Treatment	-



Background Calculations

LGOP Equation 10.1 - Stationary CH₄ from Incomplete Combustion of Digester Gas (anaerobic facilities only, site-specific data)

Measured Digester Gas Production (ft ³ /day)	× Measured % CH ₄ in Digester Gas	× Methane Density (g/m ³)	× 1 - CH ₄ Destruction Efficiency	× m ³ /ft ³	× day/yr	× MT/g =	N
0	0%	662	1%	0.028316847	365.25	0.000001	

LGOP Equation 10.3 - Process CH₄ from Anaerobic and Facultative Wastewater Treatment Lagoons (site-specific data)

Measured BOD ₅ Load	× 1 - Measured BOD ₅	× Maximum CH ₄ Production Capacity	× Anaerobic CH ₄				
...	Solid Waste-Entry	Wastewater-Control	Wastewater-Entry	Wastewater- Calcs	Electricity-Entry	Electricity-Data	Electricity- ...

Solid Waste

Hartford, like any city, generates waste from residences, commercial facilities and local events. As per the Local Government Operation Protocol (LGOP), (which this EPA tool is based on), if the government does not own or operate the solid waste facility where its waste is disposed of, the emissions associated with the decomposition of waste produced directly or indirectly by government operations activities are classified as Scope 3 emission sources. So really fundamental factor for Solid Waste GHG Inventory Management is if the



city municipality has operational control over the landfills. In other words, does Hartford own and operate the Landfills that accepts Hartford’s waste?

On the Solid Waste Control Sheet users can enter data and answer questions about Hartford’s solid waste disposal system. Based on these answers the Solid Waste Control Sheet will populate ‘City of Hartford specific’ questions.

Solid Waste - Control

[Return to Table of Contents](#)

Check if you

Use this sheet to answer questions about your city's solid waste services.
Your answers to these questions will determine how your solid waste system emissions are calculated on the following sheets.

Please answer the following questions about your municipality's solid waste services.

1) Does your municipality have operational control over any landfills (i.e., do you own or operate the landfill that accepts your waste)?

No

If no, then it is optional to report emissions for waste generated within your borders, but landfilled elsewhere, as Scope 3 emissions. If you would like to do so, please enter results on the Waste Generation sheet.

[Calculate Scope 3 Waste Production Emissions](#)

As of August 2016, Hartford **does not** own and operate its own landfills and this is outsourced to a third party vendor. Since Hartford does not own and operate its Landfills reporting for these emissions is optional and would be considered Scope 3 emissions. The focus of this report is Scope 1 and 2 emissions so this detailing has been left out however more can found here. <https://www.epa.gov/wastes/conserves/tools/warm/index.html>. The data required to use this tool is the amount of trash generated by government facilities.

Wastewater

The focus of this report is on government operations. Just like Solid Waste management, the city of Hartford doesn’t have operational control over the wastewater treatment facility therefore it is optional to report these emissions. (see the Local Government Operation Protocol for more details). The emissions from processing wastewater from government facilities would be captured in a larger community inventory. If we have data on water use by government operations, there is a module to calculate scope 3 emissions related to water use (from energy use to pump the water) but this doesn’t include the wastewater treatment portion. Unfortunately, at this point this data to calculate Scope 3 is unavailable.



Note: Wastewater management and treatment is outsourced to MDC (The Metropolitan District Hartford, Connecticut)

Mobile Combustion

The mobile combustion sheet should be filled out with information about fuel used by the City of Hartford's vehicle fleet. Typically, this includes Fuel consumed (by fuel type) (gallons or G.G.E.), Vehicle Miles Traveled (miles), Vehicle Model Year and Vehicle Type. If all this data is not available, enter as much as possible including estimations/assumptions and state clearly in the accompanying report which assumptions/estimations have been made and on what basis.

Mark Fontaine, DPW Asst. Superintendent at the City of Hartford can provide data about the city Fleet. This information comes from the supplier East River Energy; including Data for Gasoline for 40 Jennings Road and Colt Park and Diesel numbers for 40 Jennings, Colt Park, all Hartford Fire stations (3), and all flood control pump stations (6).

Mobile Combustion - Entry

[Return to Table of Contents](#)
 Check if you have completed this sheet.

After you have completed data entry, please click on the "Update Calculations" button in Step 2 below.

1a) Describe the vehicle(s) you are entering

ID#	Vehicle or vehicle group description	Department
1		

Vehicle Year	Vehicle Type	Vehicle Model (optional)	Fuel type

1b) Enter the activity data for the year 2015

Fuel consumed ():

Vehicle miles traveled (VMT)*:

Add/Update Record
Reset Form

Edit Record
Delete Record

* Helpful Hint: if you do not know the VMT for this entry, you can multiply the fuel consumed by the MPG of the vehicle/vehicle group. Use your own efficiency data or see the table below for average MPG by vehicle type and fuel. → $Vehicle\ Miles = Gallons \times Miles/Gallon$

Vehicle Type	Average MPG	
	Gasoline & Other Fuels	Diesel & Biodiesel
Passenger Car	24.1	32.4
Light Truck	18.5	22.1
Heavy-Duty Vehicle	10.13	12.96
Motorcycle	50	N/A

2) Once you have completed data entry, hit the button below to update the calculations.

Update Calculations

Since the tool is setup for multiple levels of granularity, data can be inputted based on what is available. Each vehicle can be inputted separate or totals can be entered. The most important section is 1b which includes total fuel consumption by fuel type for the inventory year. The tool asks for Fuel consumed and Vehicles Miles traveled (VMT). If VMT is unknown, you can multiply the fuel consumed by the MPG of the vehicle or vehicle group. Use your own efficiency data if that's available or see the table below for average MPG by vehicle type and fuel.



Formula

Vehicle Miles = Gallons X Miles/Gallon

Vehicle Type	Average MPG	
	Gasoline & Other Fuels	Diesel & Biodiesel
Passenger Car	24.1	32.4
Light Truck	18.5	22.1
Heavy-Duty Vehicle	10.13	12.96
Motorcycle	50	N/A

Electricity

The Electricity Entry Sheet is relatively simple and self-explanatory. On the sheet the user can enter data for each entity added on the main Control Sheet. In the case of the City of Hartford, City wide data can be inputted. As and when more detailed data becomes available the sheets can be adjusted and data can be entered accordingly. Entries can be made for any level of granularity, city, department building, account or even meter.

Electricity Use - Entry Return to Table of Contents Check if y

Data Entry & Calculations

On this sheet, you can enter electricity use for each entity for which you have data. These entities may be of any scale—the entire city, city departments, buildings, or individual meters.

To use the form below, first enter the data for a given unit, then click "Add/Update Record." The data will be saved, and the fields will remain filled in. The purpose of this process is to facilitate similar data entries for multiple entities. **Note: you will receive a confirmation message when the record has been successfully added.** At any point, you may click "Reset Form" to clear all fields. (If you would like to enter more than one record at a time, you may proceed to the "Electricity-Data" sheet and directly add data there.)

If you would like to change any aspect of a previous entry, select "Edit Record." A drop-down menu will appear. Select the entry you would like to change, make changes to the entry fields as needed, then click "Add/Update Record." To delete a record entirely, click the "Delete Record" button. A dropdown menu will appear for you to select the entry to delete. After you confirm that you would like the entry deleted, the saved data will be erased.

1) Describe the electricity consuming unit you are entering

ID#	Unit Description	Facility Type (if applicable)	Department
3	City		0

2) Enter the activity data for the year 2015

Electricity Consumed (kWh)	Electric Utility
39,557,968	0

The user can enter the description of the entry; example 'City' or 'Libraries', the Facility type and Department information if applicable. Then for each entity the kWh can be inputted. After each entity has been made, click the 'Add update Record' to ensure each entity gets saved before inputting the next one. Once all entities have been updated click the Check for completed form to ensure the records are updated. This can be checked on the Electricity-Data and Electricity-Calc tabs as they will reflect an analysis of what is entered. Details of how each department compare to each other and the breakdown of each gas can be noted.



EverSource

For Hartford, EverSource is the utility that provides electricity. Data for consumption history for the city and the breakdown of various departments can be found on GreenButton and the new Customer Engagement Platform being currently rolled out. (August 2016). Daniel Haim, City Architect is the owner of this information on the City side. Contacts on the Eversource side include Stephen Gibson (stephen.gibson@eversource.com) and James Siegel (james.siegel@eversource.com).

Stationary Combustion

Stationary combustion of fossil fuel data can be inputted into this tab. For Hartford, as of August 2016 the only fuel is Natural Gas. Combustion of stationary fuels other than natural gas is not collected. Natural gas is likely the most commonly used fuel.

Natural Gas

The City of Hartford's main source of stationary combustion GHG gases is from natural gas combustion. Much like the electricity input sheet, the stationary combustion sheet is relatively simple and self-explanatory. On the input sheet the user can enter data for each entity added on the main Control Sheet. In the case of the City Hartford, City wide data can be inputted. As and when more detailed data becomes available the sheets can be adjusted and data can be entered accordingly. Entries can be made for any level of granularity, city, department building, account or even meter.

Connecticut Natural Gas/UI

The utility providing natural gas to the City of Hartford is UI or formerly known as Connecticut Natural Gas. UI's internal database system does not have the capability to provide a list of City of Hartford's accounts so this information needs to come from the City. Typically this is available with Finance department within the DPW. This list is up to date as per the City's knowledge. Once this list of account numbers is provided to UI, they will send over usage history associated with those accounts. The contact person on UI's end is Erik Robie and he can be reached at erik.robie@uinet.com.

Tool Analysis and Additional Data tabs

Additional Emission Sources

In addition to the entry sheets and data sheets, the tool provides an opportunity to input additional emission sources that are nonspecific or unclassified. This tabs allows the user to assign each source to a city department, note what scope the emission falls under, and enter any greenhouse gas emissions in metric tons of carbon dioxide equivalent. Data for up to 10 additional emission sources can be entered.



Summary- Emissions

This sheet provides a final summary of the GHG emissions. Total City of Hartford emissions, the break down by source, and gross emissions can be viewed in helpful tables and graphs. If department information has been entered, an easy to read comparison table is populated automatically. Graphs and figures from this tab can be taken out and inputted into presentations and reports.

Factors

This sheet shows all factors used to calculate Hartford's GHG emissions. The unit conversion factors are standard conversion factors that apply to multiple sheets in the tool. Every inventory sector additionally has a separate customized section. This sheet should be used as a reference to understand factor sources before inputting.

Data Management

Activity Data

Data is collected differently for almost all emission sources for Hartford's inventory. The table below shows a list of data types and contacts for each document collected by emission source. The next section, Data Management, discusses any post processing or data manipulation required for these files before emissions calculations are performed.

Emission Source	Contact/Data Holder	Description of Data Type
Electricity	Daniel Haim from the DPW, James Siegel from Eversource	Electricity (kWh) history for most government buildings available through Eversource ; either Green Button or the Customer Engagement Platform currently being rolled out. Data up to June 2016 is also available in Emsys- the SourceOne data management system however this is contingent upon the city renewing its contract with Source One.
Natural Gas	Daniel Haim from the DPW, Erik Robie from UI/Connecticut Natural Gas. Stephanie Rogers from Eversource Municipality assistance program can also help acquire this information.	Natural Gas Data is available through UI/Connecticut Natural Gas . The total number of accounts and account numbers need to be provided by the City of Hartford as UI's internal database cannot sort by customer name. This data is more challenging to acquire; so begin early.
City Fleet Vehicles	Mark Fontaine, DPW Asst. Superintendent	Gallons of fuel by fuel type (diesel and gasoline) are available through Mark and from supplier East River Energy .



Emission Source	Contact/Data Holder	Description of Data Type
Wastewater	Optional	<p>The following are the data points:</p> <ul style="list-style-type: none"> • Total Wastewater Treated (million gallons) • Land Applied Biosolids (dry metric tons) • Digester Gas Produced per Day (std ft3 / day) • BOD5 Load (kg / day) • Digester Gas used to Generate Heat for Digester (%) • Digester Gas Flared (%) • Fraction CH₄ in Biogas (%) • BOD Removed through Primary Clarifiers (%) • Total Nitrogen Discharged in Effluent (kg N/ day)
Waste	Optional	<p>Short tons of waste by disposal method:</p> <ul style="list-style-type: none"> • Landfill • Recycling • Compost <p>This is for the waste controlled by the City of Hartford</p>
		<p>Short tons of waste generated at the festivals in Hartford by disposal method:</p> <ul style="list-style-type: none"> • Landfill • Recycling • Compost

Data Management

This section describes the process for preparing the data for the emission calculations from the original source to the data entered into the calculation worksheet. This process is not currently integrated with any other city reporting tools or processes. In the future if any integration is possible, it should be considered.

Emission Source	Data Manipulation
Electricity	Electricity is provided in kWh for all customers. The kWh can be directly entered into the emission calculation.
Natural Gas	Natural gas is provided in therms for all customers. The therms can be directly entered into the emission calculation.
City Fleet Vehicles	Gallons of fuel for gasoline and diesel can be directly entered into the emissions calculation.
Solid Waste	Not applicable (outsourced)
Wastewater	Not Applicable at this time. (outsourced)

Goal Tracking Management

The City of Hartford has multiple programs ongoing and coming soon that could lead to significant energy savings and therefore GHG gas reductions. It is imperative to track these programs closely and analyze the results. In order to do so, data on kWh, therms or fuel reduced as a result of these programs must be tracked.



However, emissions can change year over year for multiple reasons. It is often good to be able to explain some of the changes. Here are a few items that can potentially affect emissions:

- Square footage
Daniel Haim, building official, can provide data on the amount of square footage added for commercial buildings every year.
- Population
Population can be pulled from the city of Hartford's website annually.
- Industry changes
Industry changes will have to be uncovered through discussions with public works, city administrators and local knowledge of Hartford.
- Extreme weather differences
An extremely cold winter can affect the energy use significantly so the GHG analysis should be normalized to account for such an occurrence. Exact impact can be uncovered through discussion with Public works and City administrators.

Data Collection Process – Normalization Factor

The City of Hartford is responsible for updating the GHG emissions inventory annually and comparing emissions year over year and to the base year. If a different tool is used, the data should be normalized to adjust the differences between the tools.

Data Collection Process – Quality Assurance

As with all GHG inventories, there is inherent error in emissions factors and global warming potentials as science evolves and assumptions change. This error is largely out of Hartford's control. The main sources of error that are somewhat in Hartford's control are data gaps and data quality issues. The purpose of this Government Operations GHG inventory is to inform Hartford and interested citizens of its GHG emissions, and where the main sources of GHG emissions are within the city operations. The inventory will also help the City of Hartford pinpoint the areas that are worth a focused effort for emissions reductions. It is by no means binding and meant to provide a generic analysis and not a compressive one.

At this time, Hartford is focusing on emissions occurring from operations that the city has some influence over or can impact with programs and rulings.

Frequency

The City of Hartford should collect data and calculate an emissions summary annually based on calendar year data. Typically, the data required will not be available until July or August.



Therefore, this inventory should be completed in the late summer or early fall. However, data that are available sooner can and should be collected earlier, in order to allow for an efficient calculation once the final data are available. If data cannot be collected annually due to resource constraints, they should be collected every other year at the very least. Allowing too much time to pass between inventories increases chances of errors, missed data and inconsistencies in numbers across years.

Base Year

Making meaningful comparisons of emissions data over time is an integral part of any GHG inventory analysis that is credible, transparent and useful to all stakeholders; city and citizens.

An important factor for such a comparison is a consistent data set over time, or in other words, comparisons of 'like with like' over time. In order for this condition to be fulfilled, the inventory boundary must be held consistent between those data sets that are used for a direct comparison over time. In other words, we should ensure to compare apples to apples and not apples to oranges. As such, the Base Year is the most important component, as it serves as a reference point with which each year's emissions can be compared.

In order to maintain the consistency between data sets, base year emissions need to be recalculated when structural changes occur in Hartford that change the inventory boundary.

Adjustment – Recalculating Emissions

In order to ensure that the current year can be accurately compared to the base year, it is important to track and update any information that could potentially cause a base year adjustment. If it meets the threshold, then the base year emissions should be restated.

Below is a list of some potential areas that may trigger a recalculation of the base year emissions:

- **Structural changes in the inventory boundary.** Structural changes include sources that may previously have been considered insignificant but because of recent changes are now considered significant. For example, the current geographic boundary is the city limits. If significant growth occurs outside the city limits, but inside the urban growth boundary, the city limits may no longer be the accurate boundary. However, if the emission source did not exist during the base year, then no recalculation is necessary, it simply increases the current emissions. Industry or residences that grow (in production or size) do not trigger recalculation of base year emissions, only if something was previously excluded should it be recalculated in the base year.



- **Changes in calculation methodology or improvements in data accuracy.** For example, if a better estimation technique for transportation data becomes available, and this can be applied back to the base year, this would trigger a base year recalculation. If more accurate/ complete data are available from Xcel Energy this could trigger a base year adjustment.
- **Discovery of significant errors.** If an error or multiple errors are discovered that meet the threshold, base year emissions should be restated with the more accurate data. Even if base year data need to be estimated, but the estimate is more accurate than the current data for the base year, this triggers a recalculation.

Auditing and Verification

Internal Auditing

Who? Sustainability Co-coordinator.

Recommendation: An employee or stakeholder that did not directly compile the data and calculate the emissions should perform the internal audit. However, this person should be proficient with data analysis and Excel and GHG emissions as much as possible. This review should occur before the emissions summary is sent to City Council or posted anywhere publicly. There should be enough time to correct data errors, or go back to data holders with any pressing questions.

External Validation and/or Verification

Not pursued at this time but can be through EPA tools and certifications.

Management Review

Recommendation: Ideally someone on City Council or a city employee will review the high level emissions to ensure they are reasonable. Before emissions are submitted to City Council, a stakeholder who has not been as involved in the data collection and calculations should review the data files for any cell reference mistakes or emission factors.

Corrective Action

Recommendation: Each year there is the possibility of uncovering an error or omission in the data from a previous year or a methodology change. Accordingly, the baseline year inventory report must be updated and updates should be recorded clearly for future reference.



References

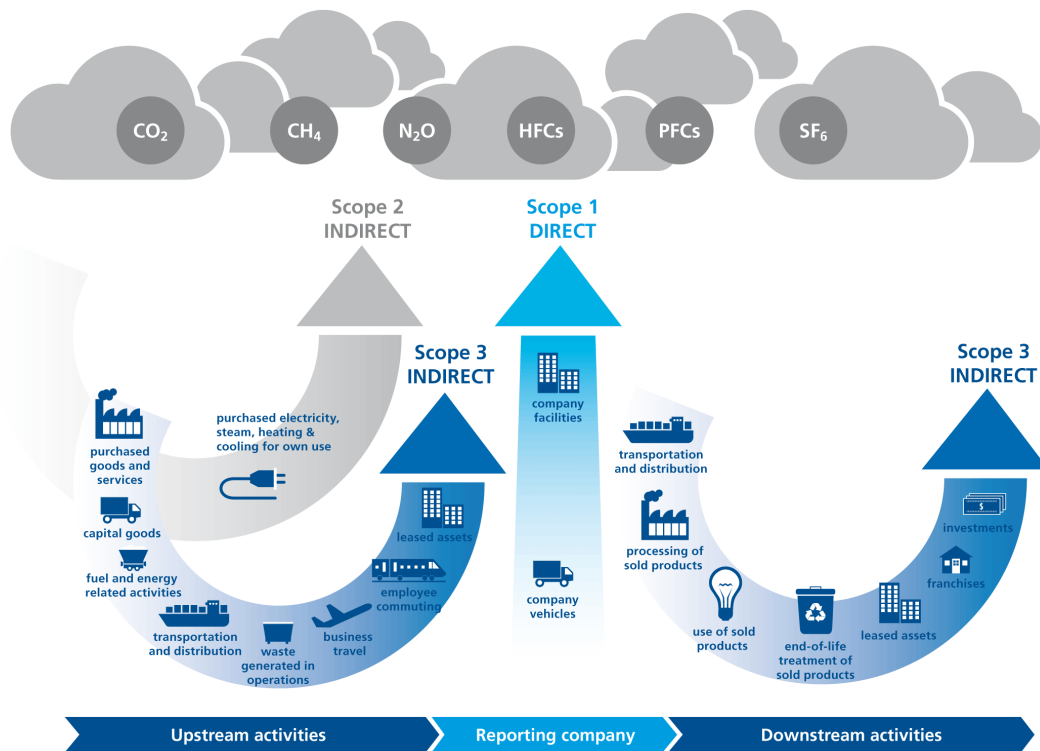
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APPENDIX

Overview of GHG Protocol scopes and emissions across the value chain



Source: myclimate.org - World Resources Institute & World Business Council for Sustainable Development, 2011.



Hartford-Pledge-Signed2.5.13.pdf - Adobe Acrobat Reader DC

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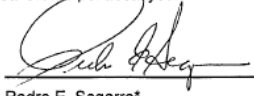
4. The City of Hartford may satisfy the voluntary purchase requirement by purchasing Green-Certified Energy certified Renewable Energy Credits (RECs), enrolling one or more municipal facilities in the CT Clean Energy OptionsSM program, installing renewable energy systems (provided that the RECs associated with such system(s) are quantifiable and not held by a third-party) or any combination thereof.

e. There is no penalty if the City of Hartford fails to meet the items set forth in the schedule above; however, the City of Hartford will not be eligible to receive incentive rewards from CEFIA under the Clean Energy Communities program.

3. The City of Hartford agrees to promote energy efficiency and clean, renewable technologies in its community. The City of Hartford is encouraged to establish a Clean Energy Task Force, or comparable body. This entity will assist the municipality in meeting the Clean Energy Communities Municipal Pledge and to perform education and outreach among residents, businesses and institutions within the community concerning energy efficiency and clean, renewable energy programs.

By taking the pledge and meeting the Clean Energy Community Program requirements outlined by CEFIA and the Connecticut Energy Efficiency Fund, the City of Hartford may qualify, subject to the terms of separate formal contracts, for the following grants:

- a. CEFIA. For every 100 points, the City of Hartford may earn a 1 kilowatt (or equivalent) clean energy system.
- b. Energy Efficiency Fund. For every 100 points, the City of Hartford may earn a Bright Idea Grant that can be used for energy-saving projects. The City of Hartford is eligible for two Bright Idea Grants per fiscal year.



 Pedro E. Segarra*
 Mayor
 City of Hartford

2/5/13

* The City of Hartford understands that the Clean Energy Communities Municipal Pledge is not a contract, and that CEFIA, the Energy Efficiency Fund, and the Companies have not contracted, committed, agreed or promised, to perform or incur any obligations, in any manner, hereunder.

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