

Local Greenhouse Gas Inventory Tools for Government Operations and Communities

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ABSTRACT

The U.S. EPA State and Local Branch has provided guidance and technical support to states 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 and transparent manner. Understanding these emission levels for government operations and community activities 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 modules are flexible to meet each localities needs and can be conducted at varying levels of detail. For example, a high-level inventory can be conducted by entering data for the city as a whole. Alternatively, users can enter data at the department level, the facility level, the account level, or any combination of the above. The more specific the data provided, the more accurate the tools will be for estimating GHG emissions and more helpful for developing targeted emissions reduction measures. In this paper, we will provide an overview of the new Local GHG Inventory Tool and provide examples of how the outputs can inform mitigation actions at the local level.

INTRODUCTION

Local governments are increasingly taking action on climate change as impacts of a changing climate are being experienced at a local level, and many governments and communities are seeking opportunities for greenhouse gas (GHG) reductions to reduce potential future impacts. As evidence to the importance of climate change at the local level, the U.S. Conference of Mayors has signed on 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). These commitments at the local level will lay the foundation for implementing mitigation measures that will have an impact nationwide. In order for localities to gauge their progress towards meeting GHG goals and targets, they must first examine the current level of emissions and establish a base year by which to measure future GHG reduction efforts. The Local Tool, developed by the U.S. EPA State and Local Branch, will assist localities to accomplish this first step of examining their base year GHG emissions.

The U.S. EPA State and Local Branch has a long history of assisting their stakeholders in developing GHG inventories, beginning with inventories at the state level. The EPA developed the States Workbook for estimating GHG emissions in the 1990s, and in 1998, EPA revised the States Workbook under the EPA's state Emission Inventory Improvement Program (EIIP). The goal of EIIP

was to promote the development and use of standard procedures for collecting, calculating, storing, reporting, and sharing air emissions data. During this revision, the States Workbook was expanded to follow the format of EIIP guidance documents for criteria air pollutants and renamed as EIIP Volume VIII. The result was a comprehensive, stepwise approach to estimating GHG emissions at the state level. This detailed methodology was appreciated by states with the capacity to devote considerable time and resources to the development of emission inventories. For other states, the EIIP guidance was overwhelming and impractical for them to follow from scratch. EPA recognized the resource constraints facing the states and developed the SIT, an Excel-based tool that automates the calculations outlined in the EIIP guidance.

EPA leveraged this experience at the state level to develop the local inventory tool modules for local governments and communities. The detailed methodology found in local guidance documents is appreciated by localities with the capacity to devote considerable time and resources to the development of emission inventories; however for some localities the local guidance documents can be overwhelming and impractical for them to follow from scratch. In addition, if a local government does not have the resources to join national climate programs that require a fee to join, it is more difficult for them to access GHG estimation models and inventory experts.

EPA recognized the resource constraints facing localities and developed the Local Greenhouse Gas Inventory Tool (LGGIT).¹ The LGGIT covers most major sources of GHG emissions estimated by localities and incorporates state-of-the-art accounting methods into a user-friendly, worksheet-style format that reduces the resource intensity of developing GHG estimates while increasing accuracy and consistency across states. The tool allows local governments to quickly create a base year inventory, and move onto identifying and implementing mitigation efforts.

The Local Tool modules correspond to guidance in the LGOP and GPC and automate the steps localities would need to take in developing their own emission estimates in a manner consistent with prevailing local guidelines. EPA recognized a need for a Local Tool to estimate greenhouse gas emissions from local governments and communities that would help localities achieve the goal of encouraging action and reducing emissions. The target audience for the Local Tool is smaller governments and localities that want to do a relatively simple analysis of GHG emissions, and do not require the detailed analysis that might come with other options. The Local Tool has undergone peer review, and the comments received through the peer review process have been incorporated into the modules. This paper provides an overview of the structure and function of the Local Tool Modules including the activity data and emission factors used by the modules, and summarizes potential uses for the emission estimates.

BODY

The Local Greenhouse Gas Inventory Tool

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 helps 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. Organizing a GHG inventory by scope provides a logical way to organize emission estimates based on the operational control of a locality. In addition, according to LGOP (2010), organizing an inventory by scopes allows for a locality to separately account for direct and indirect emissions, to improve transparency, and to provide utility for different types of climate policies and goals. Both modules are organized by the 3

¹ A tool for tribes was developed in addition to the LGGIT, to assist tribes in conducting a GHG emissions inventory.

scopes provided in the LGOP guidance: Scope 1 including all direct GHG emissions; Scope 2 including all indirect GHG emissions associated with the consumption of acquired electricity, steam, heating, or cooling; and Scope 3 including all other indirect emissions not included in Scope 2 estimates, such as waste generated and water used by the locality.

The Government Module’s structure is based on the scope and source of emissions inventoried, as shown in Table 1. The module includes ten main sectors of municipal government emissions, with an additional option of calculating emissions outside the tool and adding these estimates into “Additional Emission Sources.”

Table 1. Scopes and Sources 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

The scopes included in the Community Module vary slightly, as employee commuting is not included within the Scope 3 estimates, and the sectors for data entry are pre-defined (accounting for data entry into the residential, commercial/institutional, industrial, and energy generation sectors). The Community Module’s structure is based on the scope and source of emissions inventoried, as shown in Table 2.

Table 2. Scopes and Sources Included in the Community Module of the LGGIT

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

Prior to starting an inventory, the locality must first set boundaries to determine which emissive activities within the locality will be included, and ensure double counting does not occur (both within and among localities). One area particularly susceptible to double counting is with Scope 1 and 2 emissions from electricity generation and use. Because electricity consumption within a locality does not necessarily correspond to electricity generated in that locality, emissions from consumption (indirect emissions) are not likely to be the same as emissions from generation (direct emissions). In addition, many GHG accounting programs recognize that Scope 2 emissions reported by one entity may also be

reported as Scope 1 emissions from another entity (LGOP 2010), and that sometimes a locality will have both Scope 1 and 2 emissions related to electricity generation and consumption. If a locality has an electric generating station within its boundaries, Scope 1 and Scope 2 emissions should be reported separately as the mitigation actions to address emissions will vary. Emissions estimates across scopes should not be added, emissions can only be aggregated meaningfully within a scope, not across scopes (LGOP 2010).

The same distinction can be made with direct and indirect estimates from waste generation – where the emissions from a landfill within locality do not necessarily correspond to waste generated within the locality. Scope 1 emissions for solid waste are included when a landfill falls within the operational boundary of a locality even if the landfill manages waste from neighboring jurisdictions. Scope 3 solid emissions account for the waste generated by a locality and disposed of in a landfill outside of its organizational boundary. Estimating and tracking Scope 3 emissions over time can help a locality estimate the effectiveness of recycling and composting programs, for example.

Activity Data

The Local Government Greenhouse Gas Inventory Tool is designed to accept any level of data granularity in order to be flexible to the needs and constraints of different municipalities. Data can be entered at any scale, ranging from city-wide activity data to data by facility or meter. The more specific the data provided by the user, however, the more accurate and useful the tool will be. Localities have the option of either completing a “quick” inventory or a more thorough inventory. For the quick inventory estimate, localities can enter, for example, municipality-wide fuel, electricity, and water consumption data. While this method takes less time to complete, the emission estimates are not as detailed and may not be as useful for mitigation planning. For a more thorough inventory estimate, fuel, electricity, and water use can be entered, for example, by facility or meter. Data can also be entered at a more moderate scale – such as by department or neighborhood. While a more thorough estimate is more time intensive and is subject to data availability, this level of detail enables the locality to approach mitigation planning at a more comprehensive level.

Within the modules, background data on the locality (such as inventory year for base year measurements, department names, electricity emission factors) are entered on the Control Sheet, and are used to set up the tool. Depending on what data are available and at what scale, the user can determine how to configure the tool. Departments do not need to correspond to every department within the municipality, but can be set up to reflect organizational units for which the most comprehensive data are available. For example, if the user has City-wide data, they may set up only one department, "City." Alternatively, if the user has data disaggregated by billing units which are different from city departments, they may name the "Departments" after those units (such as public works, parks and recreation, administrative services, etc). Since city departments do not exist at the community level, the departments for the Community Module are pre-defined as residential, commercial/institutional, industrial, and energy generation sectors.

Activity data can either be entered on entry sheets or data sheets (if using the batch import functionality). Throughout the tool, the cells where the user is required to enter data are shaded yellow. The required data inputs for the Government module are provided in Table 3.

Table 3. 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)	<ul style="list-style-type: none">• Stationary fuel use (by fuel type)
Electricity Consumption	<ul style="list-style-type: none">• Electricity consumed (kWh)• Electric utility
Mobile Combustion of Fossil Fuels (i.e., fuel use by city fleet)	<ul style="list-style-type: none">• Fuel consumed (by fuel type) (gallons or G.G.E.)• Vehicle Miles Traveled (miles)• Vehicle Model Year• Vehicle Type
Solid Waste Management	<ul style="list-style-type: none">• City Landfills (number)• Landfill Gas Collected (MMSCF/yr)• Fraction of CH₄ in landfill gas• Landfill Gas Collection Area (fraction)
Wastewater Treatment	<ul style="list-style-type: none">• Wastewater treatment process details (aerobic, anaerobic, nitrification, denitrification)• Population served by wastewater treatment system(s) (people)• Population served by septic systems (people)• Digester gas produced daily (ft³/day)• Fraction of CH₄ in biogas• System BOD₅ load/influent (kg BOD₅/day)• Fraction BOD₅ removed in primary treatment• Industrial Nitrogen load (kg N/day)• Average total Nitrogen discharged (kg N/day)
Employee Commute	<ul style="list-style-type: none">• Number of employees (people)• Employees who use each mode of transit (%)• Average one-way commute length (miles)• Work days per year (days/yr)
Agriculture & Land Management	<ul style="list-style-type: none">• Synthetic fertilizer use (short tons N)• Organic fertilizer use (short tons)• Manure fertilizer use (short tons)
Urban Forestry	<ul style="list-style-type: none">• Total urban area (km²)• Urban area with tree cover (%)
Waste Generation	<ul style="list-style-type: none">• Waste emissions (MTCO₂e from EPA's Waste Reduction Model)• Department contribution to total waste (%)
Water Use	<ul style="list-style-type: none">• Percentage of imported water (%)• Water use (gallons)
Additional Emission Sources	<ul style="list-style-type: none">• GHG emissions from each additional source, by gas (MT CO₂e)

Entry sheets can be used to enter fuel use data for each entity for which data are available. Entities entered on the entry sheets may be of any scale—the entire city, city departments, buildings, or individual equipment such as furnaces. **Figure 1** provides an example of the Entry Sheet in the Local Module, on the electricity (Scope 2) entry sheet. Data are entered in the yellow cells of the Entry sheets, and are documented on the corresponding Data sheet for a particular sector.

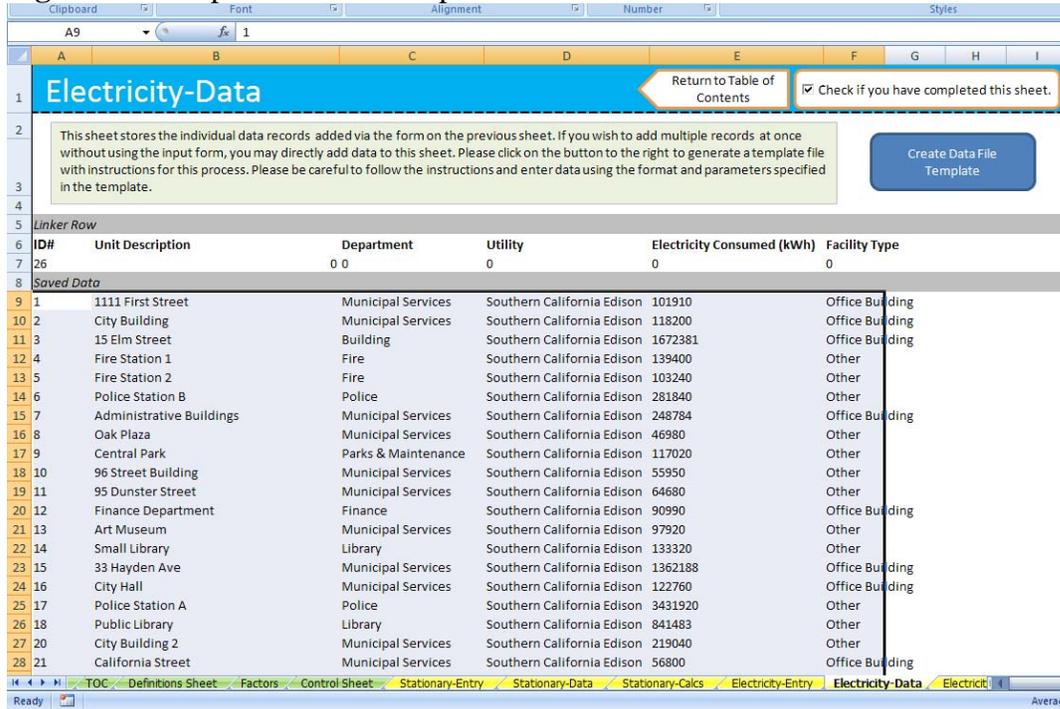
Figure 1. Example of an Entry Sheet in the Local Module

The screenshot shows an Excel spreadsheet with the following structure:

- Row 1:** Title "Electricity-Entry" in a blue header cell. To the right, there is a button "Return to Table of Contents" and a checkbox "Check if you have cor".
- Row 2:** Section header "Data Entry & Calculations".
- Row 3:** Instructional text: "On this sheet, the user 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." Below this is a detailed paragraph explaining the data entry process, including instructions on how to add, edit, or delete records.
- Row 7:** Four buttons: "Add/Update Record", "Edit Record", "Delete Record", and "Reset Form".
- Row 8:** Section header "1 Describe the electricity consuming unit you are entering".
- Row 9:** Table headers: "ID#", "Unit Description", "Facility Type (if applicable)", and "Department".
- Row 10:** A single data entry row with yellow background cells. The "ID#" cell contains the number "1".
- Row 13:** Section header "2 Enter the activity data for the year 2008".
- Row 15:** Table headers: "Electricity Consumed (kWh)" and "Electric Utility".
- Row 16:** A single data entry row with yellow background cells.

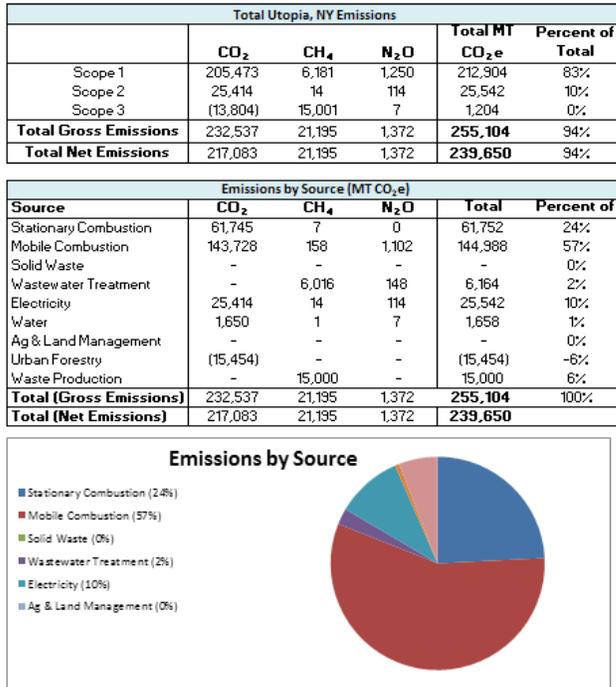
If a large volume of data are available and localities want to enter multiple records at once without using the input form, the data sheets can be used. This is available for some sources (Stationary Combustion, Electricity Use and Mobile Combustion), where the activity data can be entered using a “batch import.” The batch import allows for a municipality to upload multiple lines of data at one time. A template is generated from the tool that the locality can then use to collect and enter data. Once the data file is complete, user’s can batch import the data into LGGIT. The benefit of this approach is that a data file template can be exported from the data sheet, and circulated to different departments to update with the electricity consumed (for electricity consumption, for example). **Figure 2** provides an example of the bath upload on the Data Sheets in the Local Module, on the electricity (Scope 2) data sheet.

Figure 2. Example of a “batch import” on the Data Sheets



Once the activity data are entered, on Entry and Data sheets, they are converted into emission estimates on the Calculation sheets. These Calculation worksheets provide a transparent calculation for each department with activity data and show a step-wise calculation for each. The results of the calculation are shown in tables and graphs that can be used in a Local GHG Inventory Report. All of the emissions estimates are summarized in tables and graphs on the Summary worksheet, shown in Figure 3.

Figure 3. Emission estimates by scope and source on the Summary worksheet.



Emission Factors

In general, the LGGIT is pre-programmed with default emission factors and system assumptions needed to calculate emissions from the LGOP and Global Community Protocol. Wherever possible in the inventory process, default values provided by the LGOP are used. The tool provides users the option to use default data or to override default values if they have city-specific information.

Table 4. Source of emission factors in the Local Tool.

Scope 1	Emission Factor Source
Stationary Combustion	U.S. EPA, Mandatory Reporting Rule (U.S. EPA, 2014)
Mobile Combustion	U.S. EPA, National GHG Inventory (U.S. EPA, 2013)
Solid Waste	
Wastewater	
Scope 2	
Electricity Use	EPA's eGRID (U.S. EPA, 2011)
Scope 3	
Employee Commute	U.S. EPA, National GHG Inventory (U.S. EPA, 2013)
Agriculture & Land Management	
Urban Forestry	U.S. EPA, State Inventory Tools (U.S. EPA, 2015)
Waste Generation	U.S. EPA, National GHG Inventory (U.S. EPA, 2013)
Water Use	LGOP (2010)

Using Tool Outputs

Valuable lessons can be learned from the GHG inventory produced by the Local Tool modules. Results can first be analyzed to draw “big picture” lessons and to understand the driving forces behind emissions. Important questions to consider while evaluating results could include:

- What are the largest sources of emissions in our local government's operations and the community? What are their drivers?
- Why are the emissions so high? Is it a result of activity data, emission factors, or both?
- How do our operational emissions in a sector compare to those of other, similar governments? If they are noticeably higher or lower, why?
- What are our emissions per capita? Per employee?

Understanding the driving force behind emissions will help to inform local policies targeted at emission reduction efforts for specific sectors. Using the Local Tool can help a locality to consistently monitor emissions over time (e.g., by regularly tracking key data such as energy use or by conducting an inventory every year or two) to evaluate the progress and success of mitigation efforts. The emissions estimates on the summary worksheets of the Local Tool modules can be used to inform mitigation actions across an array of potential local policies and incentives.

CONCLUSIONS

The Local Tools will add value to local greenhouse gas inventories by allowing localities to estimate emissions from government operations and from the community, and differentiate between direct and indirect greenhouse gas emission estimates. Since the Local Tools generally follow the same structure as the LGOP and GCP, states will be able to use the tools with relative ease and to aid more directly in reducing GHG emissions. The outputs will not only provide valuable information for local greenhouse gas inventory reports, but will also help inform mitigation across all sectors. Future improvements to the Local Tools may include updated emission factors and/or activity data depending on the timing and nature of future data releases. The Local Tools will be available on the EPA State and Local Branch website in June 2015. In the meantime, the EPA State and Local Branch website provides guidance on completing a GHG inventory available at:

<http://www.epa.gov/statelocalclimate/state/activities/ghg-inventory.html>.

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KEY WORDS

Local Greenhouse Gas Inventory; Local Government GHG Inventory; Community-Wide GHG Inventory