U.S. Community Protocol
for Accounting and Reporting of Greenhouse Gas Emissions

Version 1.2

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Developed by
ICLEI – Local Governments for Sustainability USA

For the latest version of the Community Protocol, and other tools and resources that can help local governments report on community GHG emissions, visit www.icleiusa.org.

Table of Contents

List of Tables

Under Separate Cover

Appendices C - I. Detailed Sector Accounting Guidance are available at www.icleiusa.org

- Appendix C: Built Environment Emission Activities and Sources
- Appendix D: Transportation and Other Mobile Emission Activities and Sources
- Appendix E: Solid Waste Emission Activities and Sources
- Appendix F: Wastewater and Water Emission Activities and Sources
- Appendix G: Agricultural Livestock Emission Activities and Sources
- Appendix H: Emissions Associated with the Community's Use of Materials and Services: Accounting for Trans-boundary Community-Wide Supply-Chains
- Appendix I: Consumption-Based Emission Activities and Sources
- Appendix J: Forest Land and Trees

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1. Introduction

1.1 Purpose and Scope of the Community Protocol

This U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions (US Community Protocol) is designed to inspire and guide U.S. local governments to account for and report on greenhouse gas (GHG) emissions associated with the communities they represent.

Many chemical compounds found in the Earth's atmosphere act as and are referred to as "greenhouse gases" that allow sunlight to enter the atmosphere and prevent infrared radiation from escaping back to space.[2] This affects global climate and temperatures. GHG emissions occur from natural processes (biogenic and physical) and also from human activities and sources (anthropogenic) such as the burning of fossil fuels. A scientific consensus has emerged that increasing concentrations of GHG emissions in the Earth's atmosphere results in increased average global temperatures. This, in turn, leads to changes in the Earth's climate that are detrimental to our economies and environment. Therefore, it is important to measure and decrease anthropogenic GHG emissions. This Protocol addresses the six internationally recognized greenhouse gases which directly impact the climate:

- Carbon dioxide (CO_2);
- Methane (CH_4);
- Nitrous oxide (N_2O);
- Hydrofluorocarbons (HFCs);
- Perfluorocarbons (PFCs); and
- Sulfur hexafluoride (SF_6).

Local governments estimate and report on community GHG fluxes using a tool known as a GHG inventory. A GHG inventory estimates the quantity of GHG emissions and removals associated with community sources and activities taking place during a chosen analysis year. By conducting additional inventories every three to five years and presenting data over time, local governments can use community GHG inventory reports to provide information on trends in GHG emissions associated with a given community. Local governments may choose to develop a community GHG inventory report for a number of reasons, including to:

- inform climate action planning
- demonstrate accountability and leadership
- track GHG emissions performance over time
- motivate community action
- recognize GHG emissions performance relative to similar communities
- enable aggregation of GHG emissions data across regions, and
- demonstrate compliance with regulations, voluntary agreements, and market standards (where applicable).

Community GHG inventory reports typically focus on selected GHG emissions occurring within the jurisdictional boundary of the community (e.g., emissions from combustion of natural gas in

[2] http://www.eia.gov/oiaf/1605/ggccebro/chapter1.html

furnaces throughout the community), as well as certain trans-boundary emission sources associated with community activities (e.g., emissions from electricity generation at a power plant located outside the community associated with electricity use occurring in the community). GHG removals may also occur, particularly in the land sector.

This Protocol establishes requirements and recommended best practices for developing community GHG inventories. This Community Protocol is designed to meet the following objectives:

Measurement

1) Enable local governments to estimate and report on GHG emissions and removals associated with their communities in order to measure progress towards GHG emission reduction goals.
2) Use best practice methods that align, where possible, with nationally and internationally recognized GHG accounting and reporting principles, as well as with emerging reporting processes or registries.

Policy and Actions

3) Provide local governments with an assessment of GHG emissions associated with their communities so that they – and others – can make more informed decisions about where and how to pursue GHG emissions reduction opportunities.
4) Help local governments engage with residents, businesses, and other stakeholders about opportunities in their communities for reducing GHG emissions.

Consistency/Comparability

5) Advance consistent, comparable, and relevant quantification of GHG emissions and appropriate, transparent, and policy-relevant reporting of GHG emissions to allow communities to compare their baseline emissions and progress towards achieving emission reduction goals.

Contribution Analysis: A technique called contribution analysis allows separating the contributions of different drivers to changes in local community emissions between multiple years' inventories. The contributions from emissions factors, population growth, per-capita usage, and weather, among others, can be separately quantified. Contribution analysis adds significant value for local governments in evaluating progress and identifying the most important areas to focus policy interventions. Consistency between inventories is particularly important for meaningful contribution analysis. It is important to carefully document inventory methods and data sources so they can be replicated in future inventories.

Building on and evolving from previous advice provided by ICLEI and others, this Community Protocol represents the national standard in guidance to help U.S. local governments develop effective community GHG inventories. It establishes reporting requirements for all community GHG inventories, provides detailed accounting guidance for quantifying GHG emissions (and removals) associated with a range of GHG sources (and sinks[3]) and community activities, and

[3] Throughout this document, it is assumed when referring to "GHG sources" that this may also include GHG sinks.

provides a number of optional reporting frameworks to help local governments customize their community GHG inventory reports based on their local goals and capacities. A number of innovations are introduced to help those new to community GHG inventories and experienced practitioners alike to gain value from best practices.

Innovations in this Community Protocol

Practitioners who have completed community GHG inventories in the past will find a number of innovations in this Protocol that may depart from how you have accounted for and reported on community GHG emissions in the past. Innovations include:

- distinctions drawn between GHG emission sources that may be located in a community and activities of the community that result in GHG emissions (section 1.3);
- five required Basic Emissions Generating Activities for all communities (section 2.2);
- multiple reporting frameworks to help you report on community GHG emissions in a manner that tells a story or stories suited to your audiences and purposes (section 2.3);
- a focus on a required *process* that helps communities achieve their emissions management goals in a variety of contexts;
- detailed accounting guidance to aid data collection and emission calculations (Chapter 3 and Appendices C – I under separate cover);
- reporting requirements that include activity data, emission factors, accounting methods, context data, and disclosure of emission sources and activities included and excluded (Chapter 4);
- emphasis on line item reporting of emissions numbers with guidance on aggregation where appropriate and how to avoid double counting (section 4.5);
- preference given to origin-destination (using a demand-based allocation model) of vehicle trips by community members, as opposed to emissions from vehicles driving inside your community boundary (Methods TR.1.A and TR.1.B, respectively in Appendix D);
- inclusion of life cycle accounting methods of upstream emissions from: electricity use (Method BE.5.2 in Appendix C), stationary fuel use (Method BE.5.1 in Appendix C), transportation fuels (Method TR.9 in Appendix D) and materials and services used in the community (Appendix H);
- new in 2019, Appendix J that provides guidance on estimating GHG emissions and removals from lands, starting with forests and “trees outside forests”; and
- inclusion of a separate accounting framework for consumption-based emissions (Appendix I).

All references to requirements within this Community Protocol refer to steps that local governments must take in order to claim that their reporting of community GHG emissions is US Community Protocol-compliant. As of its October 2012 publication and subsequent updates through 2019, all emissions accounting and reporting in compliance with this Protocol is done on a voluntary basis. Individual agencies, voluntary agreement partners, and emission markets may choose to align accounting and reporting requirements with this Protocol in the future. Local governments should be aware of any locally applicable requirements.

This Protocol guides accounting and reporting of GHG emissions associated with community-wide sources and activities. Local governments are encouraged to include information on GHG emissions associated with their own *local government operations* in the context of this broader reporting on community GHG emissions. See section 4.6 for information on the separate Local Government Operations Protocol[4] that is available to guide reporting on emissions associated with municipal operations.

In contrast to GHG emissions reports that might be developed for individual organizations or projects (e.g., by a company reporting on its own emissions to a carbon registry), community GHG inventories convey information about emissions associated with politically defined communities. They are neither exclusive of emissions separately reported by organizations in the community, nor simply the sum of emissions reported by individual organizations or households. Rather, community inventories provide new ways of understanding the collective GHG emissions stories associated with a community. They are primarily created from community-wide data sets (e.g., total energy use, total miles driven, total waste produced). While no community inventory is fully comprehensive (some emissions cannot be estimated due to a lack of valid methods, a lack of emissions data, or for other reasons), community inventories often aim to provide as complete a picture of GHG emissions associated with a community as is feasible.

Community scale accounting is a unique practice among GHG measurement endeavors. Both corporate/entity-based accounting relies on the concept of ownership of the emissions generating sources and activities as a guiding principle for inventory compilers to determine what is included. Inventories performed by nations as part of their participation in international agreements can more readily draw boundaries around sources that are under the control of the nation and its inhabitants. Likewise, corporate inventory accounting principles are grounded in concepts in control or ownership based responsibility for GHGs. Due to porous boundaries, shared infrastructure, and a recognition that a community's impact extends into activities that operate at regional scales and into the global supply chain of goods and services used by residents and business; many accounting conventions of other standards are difficult to apply. Recognizing these facts about community inventories points to treatment of their results as a kind of commons that are collectively owned and managed by the community. Acknowledging this condition is helpful in the interpretation and use of the results to not only inform decision making by local government but to engage the entire community in formulating a response.

[4] http://www.icleiusa.org/tools/ghg-protocol/local-government-operations-protocol-1/local-government-operations-protocol

A number of other protocols and accounting standards have been developed to guide the estimation and reporting of GHG emissions associated with individual organizations or projects,[5] including, but not limited to, the GHG Protocol Corporate Standard,[6] the GHG Protocol for Project Accounting,[7] the Corporate Value Chain (Scope 3),[8] Accounting and Reporting Standard,[9] and the Product Life Cycle Accounting and Reporting Standard.[10] Although this Community Protocol provides guidance on quantifying some of the same types of GHG emissions that might be addressed by organization and project-oriented protocols (e.g., GHG emissions associated with energy use), some guidance may differ from that contained in other protocols due to the community-wide scope of this Protocol. Practitioners should follow the protocol best suited to the scope of their reporting efforts. This Protocol requires community GHG inventories to report gross GHG emissions data. For that reason, this Protocol does not provide guidance on quantifying or reporting on GHG benefits associated with:

- Actions that have been or could be taken to reduce emissions
- Carbon offset projects
- Purchased carbon credits
- Renewable energy credits

Local governments have the option to include information on GHG benefits associated with these activities in the process of their reporting, so long as this information is presented separately from gross GHG emissions data calculated using the methods provided by this Protocol. It is not Protocol-compliant to solely report net GHG emission numbers (e.g., subtracting renewable energy credits from the gross emissions estimate). Information on these activities is best presented in the context of climate action plans, sustainability plans, and progress reports on the implementation of emission reduction strategies.

One exception to reporting on gross emissions is the case where a community decides to report on GHGs from land use (Appendix J). Land use is unique from other sectors in that activities in the land sector can result in *both* GHG emissions to, and removals from, the atmosphere. It is recommended to communities who include land use to report such GHG fluxes as a separate category, i.e. to continue reporting gross emissions in other sectors, while reporting net emissions (or removals) for the land sector.

1.2 Overview of Community Protocol Structure

Following this first introductory chapter, the Protocol consists of three major chapters followed by two attached appendices. Under separate cover are a Scoping and Reporting Tool and seven appendices that provide detailed accounting guidance.

Chapter 2 – Step One: Conduct the Scoping Process

[5] *The following link is to a document that describes some of the other (non-community) types of GHG inventories:* http://www.theclimateregistry.org/downloads/2010/10/Consumer-Guide-to-GHG-Accounting.pdf.
[6] http://www.ghgprotocol.org/standards/corporate-standard
[7] http://www.ghgprotocol.org/standards/project-protocol
[8] Note: the definition of a scope and other technical terms are in Appendix A: Glossary, Abbreviations, and Acronyms.
[9] http://www.ghgprotocol.org/standards/scope-3-standard
[10] http://www.ghgprotocol.org/standards/product-standard

Chapter 2 provides guidance to local governments on the process of selecting or scoping what GHG emissions sources and activities to include in their community GHG inventories. This scoping process will be informed by the goals and capacity of each local government and the stories it wishes to tell about GHG emissions associated with the community. Chapter 2 also outlines a set of Five Basic GHG Emissions Generating Activities that must be included in an inventory to comply with this Protocol, and provides optional reporting frameworks to help local governments scope their inventories in a manner appropriate to their goals and capacity.

Chapter 3 – Step Two: Perform Emission Calculations

Chapter 3 provides an overview of the detailed GHG emissions accounting guidance (provided in sector-specific Protocol appendices under separate cover) that will help local governments identify data needs, obtain data, and perform calculations to quantify GHG emissions.

Chapter 4 – Step Three: Complete the GHG Inventory Report

Chapter 4 provides guidance to local governments on developing and customizing GHG inventory reports. Protocol-compliant inventory reporting requirements are explained and guidance is provided to help local governments customize their reporting to convey the stories they wish to tell about GHG emissions associated with their communities. Guidance is also provided on organizing report data, avoiding double counting, and presenting GHG emissions data in context to add value for the reader.

Attached Appendices

- Appendix A provides a glossary of terms and abbreviations.
- Appendix B provides an "Example Community GHG Emissions Report Summary Table" that demonstrates how the required reporting data can be presented. It is recommended that a table like this be created and included in your inventory report.

Separate Appendices: Detailed Accounting Guidance

Appendices C through I are available on the ICLEI USA website as separate files to reduce document length. These appendices provide detailed accounting guidance to help local governments identify data needs, engage providers to obtain data, and perform calculations to quantify GHG emissions. These appendices are organized around the following categories of community GHG emission sources and associated activities that contribute to GHG emissions:

- *Appendix C:* Built Environment Emission Activities and Sources
- *Appendix D:* Transportation and Other Mobile Emission Activities and Sources
- *Appendix E:* Solid Waste Emission Activities and Sources
- *Appendix F:* Wastewater and Water Emission Activities and Sources
- *Appendix G:* Agricultural Livestock Emission Sources
- *Appendix H:* Emissions Associated with the Community's Use of Materials and Services: Accounting for Trans-boundary Community-Wide Supply-Chains
- *Appendix I:* Consumption-Based Emission Activities and Sources
- *Appendix J:* Forest Land and Trees Outside Forests

1.3 Introduction to GHG Emission Sources and Activities Associated with Communities

Communities contribute to greenhouse gas emissions in many ways. Two central categorizations of emissions are used in this Protocol: 1) GHG emissions that are produced by community-based "sources" located within the community boundary, and 2) GHG emissions produced as a consequence of community "activities".

Table 1. GHG Emission Sources and Associated Activities in Community Inventories

In-boundary GHG Emissions Sources	Activities Resulting in GHG Emissions
Any physical process inside the jurisdictional boundary that releases GHG emissions into the atmosphere (e.g., combustion of gasoline in transportation; combustion of natural gas in electricity generation; methane emissions from a landfill) or removes GHGs from the atmosphere (e.g., protecting and managing forests; planting or maintaining trees).	The use of energy, materials, and/or services by members of the community that result in the creation of GHG emissions either directly (e.g., use of household furnaces and vehicles with internal combustion engines) or indirectly (e.g., use of electricity created through combustion of fossil fuels at a power plant, consumption of goods and services whose production, transport and/or disposal resulted in GHG emissions).

Historically, many communities have conducted GHG inventories that have included mixtures of both sources and activities, often rolling up both types of numbers into a single total. While this Protocol allows for inventories with both sources and activities, drawing a distinction between the two can help local governments to conceptualize, organize, and report on emissions associated with their communities.

The distinction between sources and activities can help local governments decide how to group the emissions numbers they might gather for the purpose of reporting. For example, a purely source-based emissions inventory could be summed to estimate total emissions released within the community's jurisdictional boundary. This is analogous to the GPC "Territorial" reporting framework. In contrast, a purely activity-based emissions inventory could provide perspective on the efficiency of the community, even when the associated emissions occur outside the jurisdictional boundary. By reporting on both GHG emissions sources and activities, local governments can develop and promote a deeper understanding of GHG emissions associated with their communities.

Understanding the difference between sources and activities can help local governments to avoid double counting. For example, emissions associated with either sources or activities alone can generally be summed, but emissions from sources and activities should generally not be added together due to potential for double counting within the total. See section 4.5 for guidance on how the distinction between sources and activities can help to avoid double counting.

The sources and activities framework alleviates the need to utilize the "scopes" concept common in other types of organization-focused inventories, such as those developed using the Local

Government Operations Protocol.[11] The original publication of this Protocol does not use scopes as a framework for categorizing emissions in community inventories because the organization-related definitions of scopes for corporate accounting did not translate to the community scale in a manner that is clear and consistently applicable as an accounting framework. Subsequent to its original publication, the Global Protocol for Community Scale Emissions Inventories introduced a geographically defined Scopes framework that has been adopted by global registries as a consistent format for reporting. Communities wishing to participate in initiatives that include structured reporting and disclosure should consult the GPC for considering data collection methods that allow for separation of activity data along geographic boundaries.

Identifying GHG emission sources in the community and community activities that lead to the generation of GHG emissions can be a complex exercise. The following table (Table 2) provides an overview of the GHG emissions sources and related community activities for which accounting methods are provided in this Protocol. As illustrated in Table 2, several categories of emissions can be quantified from either the source or activity perspective. In some cases (such as fuel combustion in residential heating), source-based and activity-based approaches are one and the same. In other cases (such as solid waste emissions), these two approaches are very different.

[11] For example, *Local Government Operations Protocol*, ICLEI USA, California Air Resources Board, California Climate Action Registry, and The Climate Registry.

Table 2. Potential Community-Wide GHG Emission Sources and Associated Activities

In-boundary GHG Emissions Sources	Activities Resulting in GHG Emissions
Built Environment	
Use of fuel in residential and commercial stationary combustion equipment (e.g., boilers and furnaces)	Use of fuel in residential and commercial stationary combustion equipment (e.g., boilers and furnaces)
Industrial stationary combustion sources	
Power generating facilities	Use of electricity by the community[i]
District heating or cooling facilities	Use of district heating or cooling by the community
Industrial processes	
Refrigerant leakage	
Transportation and Other Mobile Sources [ii, iii, iv, v]	
On-road passenger vehicles operating within the community boundary	On-road passenger vehicle travel associated with community land uses
On-road freight and service vehicles operating within the community boundary	On-road freight and service vehicle travel associated with community land uses
On-road transit vehicles operating within the community boundary	
Transit rail vehicles operating within the community boundary	Use of transit rail travel by the community
Inter-city passenger rail vehicles operating within the community boundary	
Freight rail vehicles operating within the community boundary	
Marine vessels operating within the community boundary	Use of ferries by the community
Off-road surface vehicles and other mobile equipment operating within the community boundary	
	Use of air travel by the community
Solid Waste	
Operation of solid waste disposal facilities	Generation and disposal of solid waste by the community
Wastewater and Water	
Operation of water delivery facilities	Use of energy associated with use of potable water
	Use of energy associated with generation of wastewater
Process emissions from operation of wastewater treatment facilities	Process emissions associated with generation of wastewater
Operation of septic systems	Use of septic systems by the community
Agricultural Livestock	
Domesticated animal production	
Manure decomposition and treatment	
Forests and Lands	
Forest Lands within boundary	Direct or indirect changes to forest carbon stocks outside the community boundary, due to activities within the community boundary. Including forest protection and land use change
Trees outside forests, such as parks, street trees, and urban canopy	
Upstream Impacts of Community-Wide Activities	
	Upstream impacts of fuels used in stationary applications by the community
	Upstream and transmission and distribution (T&D) impacts of purchased electricity used by the community[vi]
	Upstream impacts of fuels used for transportation in trips associated with the community
	Upstream impacts of fuels used by water and wastewater facilities for water used and wastewater generated within the community boundary

	Upstream impacts of select materials (concrete, food, paper, carpets, etc.) used by the whole community. Note: Additional community-wide flows of goods & services will create significant double counting issues.

[i] Emissions associated with the use of purchased electricity should include delineation of electricity used in stationary applications vs. transportation vehicles to the extent possible.

[ii] Community refers to residents, businesses, industries, and government co-located within a defined jurisdiction. Across each mode, travel by members of the community often involves crossing the community boundary with a portion of travel occurring outside the community. Quantifying emissions associated with the use of travel by the community generally involves estimating emissions associated with the entire length of in-boundary and trans-boundary trips, and allocating a portion of those emissions to the community for which emissions are being reported. See Chapter 3 for further detail.

[iii] Vessels operating within the community boundary include docked or idling vessels.

[iv] Emissions associated with use of travel by the community include energy used while vehicles are docked or charging.

[v] Some communities with transportation hubs or ports may be interested in tracking emissions associated with fuel loaded into aviation, marine, or rail vessels departing from those hubs or ports. These vessels often transport people and goods associated larger geographic regions, and often most of the fuel loaded into them is combusted outside the community boundary. These emissions are not included in Table 2 for these reasons, but local governments may choose to report on them in addition to the GHG sources and activities listed in Table 2.

[vi] Upstream impacts of the use of purchased electricity can include consideration of associated transmission and distribution losses.

Independent Consumption-Based GHG Accounting Approaches

A separate reporting framework is provided in Table 3 for communities interested in estimating "consumption-based" emissions. Consumption-based accounting is fundamentally about the activity of consumption. These consumption activities cause emissions to be generated from a vast number of different sources. Because of the potential for double counting both within Table 3 and between Tables 2 and 3, consumption-based accounting is referred to below as "independent" from other approaches. For example, both "household consumption" and "life cycle emissions of community businesses" count the same emissions associated with local businesses that serve local households. See section 2.3.3 and Appendix I – Consumption-based Emission Activities and Sources for further guidance on consumption-based accounting.

Table 3. Independent Consumption-Based GHG Accounting Approaches

In-boundary GHG Emissions Sources	Activities Resulting in GHG Emissions
	Household Consumption (e.g., gas & electricity, transportation, and the purchase of all other food, goods and services by all households in the community)
	Government Consumption (e.g., gas & electricity, transportation, and the purchase of all other food, goods and services by all governments in the community)[vii]
	Life cycle emissions of community businesses (e.g., gas & electricity, transportation, and the purchase of all other food, goods and services by all businesses in the community)

[vii] Not limited to municipal or county government (for details see Appendix I: Consumption-Based Emission Activities & Sources).

1.4 Process Overview: Developing a Community GHG Inventory Report

This Protocol establishes requirements and recommended best practices for developing community GHG inventories. Local governments seeking to develop Protocol-compliant GHG inventory reports are required to proceed through three Required Steps for GHG Reporting, and

encouraged to frame their inventory reports around one or more Recommended Reporting Frameworks, as outlined below in Table 4.

Table 4. Overview of Required GHG Inventory Process and Recommended Reporting Frameworks

Required GHG Inventory Process	Recommended Reporting Frameworks
Step One: Conduct the Scoping Process To scope out what GHG emissions will be included in the inventory, consider what stories you wish to convey about emissions in your community and what reporting frameworks will help you tell those stories (recommended at right). Identify the GHG emission sources and activities to be included under those reporting frameworks. At a minimum, the following five Basic Emissions Generating Activities must be included in the inventory. • Use of electricity by the community • Use of fuel in residential and commercial stationary combustion equipment • On-road passenger and freight motor vehicle travel • Use of energy in potable water and wastewater treatment and distribution • Generation of solid waste by the community Local governments are strongly encouraged to include other sources and activities in accounting and reporting as well. **Step Two: Perform Emissions Calculations** Gather data and calculate emissions for selected sources and activities. Protocol	**Strongly Encouraged: Focus on Key Stories** Complete your GHG inventory report using one or more of the following reporting frameworks (in order of recommended priority). 1) **Significant Influence.** The GHG activities and sources over which your local government has significant influence. 2) **Community-wide Activities.** The wide set of community GHG activities of community interest, regardless of your local government's influence. 3) **Household Consumption**, regardless of your local government's influence. 4) **Market Based Inventory.** An inventory based at least partially on tradeable attributes which alter the rates of emissions intensity for various activities or exchanges of credits applied to the levels of activities. 5) **Nature Based**. An inventory that incorporates the GHG fluxes (emissions and removals) from land use. Note: These three reporting frameworks (and any additional frameworks) can be included in a single inventory report.

estimation methods must be used in Protocol-compliant inventories except where the user identifies and documents another method that is likely to better satisfy the Protocol reporting principles in Chapter 1. **Step Three: Complete the GHG Inventory Report** Develop a report that effectively conveys information about GHG emissions associated with your community, meeting the reporting requirements described in Chapter 4.	**Also Encouraged: Additional Reporting Frameworks** Expand your GHG inventory report through any or all of the following reporting frameworks: • In-boundary sources • Government consumption • Full consumption-based inventory • Life cycle emissions of community businesses • Individual industry sectors • Create your own story

Some accounting frameworks provide good opportunity to highlight the benefit of actions being taken by a community which are not captured by a standard geographic focused inventory. When these frameworks are utilized, it is important for a community to strive to account for all relevant sources and activities that fall under the framework. In other words, a reporting framework may not be used to selectively focus on only matters that work to improve the result of the GHG inventory. The box below illustrates some of the trade-offs that should be considered.

Framework Type	Positive	Negative
Market Based	Use of contractually derived emissions factors for particular power products	Out-bound credits generated from the reduction of within-boundary activities and sources
Nature Based	Sequestration of carbon from managed forest within the community boundary	Deforestation and other land use changes, attributable to activities and decisions made within boundary, that reduce carbon stocks

Telling Your Story
A GHG inventory can serve different purposes for different audiences. The US Community Protocol focus is on helping you develop and present an inventory that will be most meaningful and policy relevant for community constituents and decision makers.

Since the Community Protocol was first released, there has been an increased focus on reporting local community emissions to international campaigns supporting local action. This has driven a standardization of what is included in inventories. While this standardization is good for aggregating or comparing across inventories, greater customization is still valuable to make your inventory most relevant for local decision making.

You should be able to develop an inventory that allows your community to report the required data to international programs, if desired, and at the same time provides the data needed for local decision making. However, while both of these purposes can draw on the same data set, you will likely want to structure and present the information differently for each purpose.

The US Community Protocol Reporting Frameworks are intended to help you think about how to structure and present inventory data in the most effective way. However you may find that none of the frameworks laid out captures the best way to present data for your community. This is the reason for the 'Tell your own story' option. This option is encouraged, and communities that come up with a new way to present inventory information can help to drive the emissions accounting field forward by finding ways to structure data that are adopted by others in the future.

1.5 GHG Accounting and Reporting Principles

The following GHG accounting and reporting principles were considered in development of this Protocol and should be considered in developing an inventory. These principles are adapted from two internationally recognized sources: *The GHG Protocol: A Corporate Accounting and Reporting Standard* (World Resources Institute/World Business Council for Sustainable Development; March 2004),[12] and environmental indicators for environmental performance reviews developed by the Organization for Economic Co-operation and Development (1993).[13] Since communities are neither individual organizational entities nor nations, the principles below were adapted to the needs of a community inventory process.

> ***Relevance, Including Policy Relevance, and Utility for Users*:** GHG inventory reports developed using the Protocol should appropriately reflect GHG emissions associated with the community and be organized to be relevant for the local government's intended purposes. Inventories developed using this Protocol should be understandable and show trends over time. The Protocol encourages consideration of GHG reduction opportunities and does not discourage, stifle, or suppress continued innovation to reduce emissions. The Protocol does not reward emissions reduction actions that merely shift a community's current emissions outside its boundary, or increase global GHG emissions.

[12] http://www.ghgprotocol.org/standards/corporate-standard
[13] www.oecd.org/dataoecd/37/1/33703867.pdf

***Accuracy**:* Due to known factors that would compromise the accuracy of emissions estimates (e.g., limitations in relevant data availability or completeness) this Protocol does not recommend quantification of GHG emissions that systematically over-estimate or under-estimate actual emissions. Accuracy should be sufficient to enable users to make decisions with reasonable assurance as to the integrity of the reported information.

***Completeness**:* Community GHG inventories should be as comprehensive as possible of GHG sources and sinks, and activities associated with the community.

***Measurability*:** Data required for executing the methods that quantify GHG emissions in a community inventory have been determined to be readily available or can be made available at a reasonable cost; are adequately documented and of known quality; and will be updated at regular intervals in accordance with reliable procedures.

Consistency and Comparability: Consistent methodologies for calculating GHG emissions activities have been developed to enable meaningful trend analysis over time, documentation of reductions by the community, and comparisons of emissions among communities. Standardized, preferred GHG estimation methodologies have been developed for each GHG emission source, and disclosure of deviations from the preferred methodologies has been required.

***Transparency**:* Within the resource limitations used to develop this Protocol, all relevant issues have been addressed and documented in a factual and coherent manner to allow for future review and replication. To the extent possible, all relevant data activities and assumptions have been disclosed, along with descriptions of methodologies and data sources used. Protocol users are encouraged to report and benchmark activity and emissions context data (see Chapter 4).

The requirements and recommended best practices for developing community GHG inventory reports established in this Protocol were developed based on these accounting and reporting principles. Chapter 2 provides additional guidance on using these principles in selecting GHG emissions sources and activities to include in your inventory.

Balancing the Accounting Principles

In some cases there will be tradeoffs between the accounting principles. For example, there may be a data source that allows more completeness, but is lower in accuracy or consistency, or may not be updated on a regular basis. The correct balance to choose depends on the overall purpose and goals of the inventory.

As more local governments complete multiple community inventories and want to compare emissions over time, consistency and using data sources that are measured from local sources and updated on a regular basis rise in importance. This is especially important for local governments that are interested in doing a contribution analysis of inventory pairs. An inventory project is also often a balancing act among resources dedicated to the project and some decisions may be needed in terms of investing in the depth of knowledge about highly relevant emissions generating activities versus the breadth of coverage of all the different sources that could be accounted for.

1.6 Protocol Development Process

This Protocol was developed by ICLEI-Local Governments for Sustainability USA (ICLEI USA) to respond to the expressed needs of local governments in the United States for a standardized methodology for accounting and reporting on GHG emissions (and removals) associated with individual communities.

Protocol development decisions were made by ICLEI USA and a Steering Committee comprised of U.S. local government members and others with relevant expertise. These decisions were informed by seven Technical Advisory Committees (TACs), also comprised of members of local governments and other technical experts, who referenced what they determined to be the best of the existing emissions accounting methodologies (i.e., drawn from existing sources such as IPCC and EPA) to provide the Protocol users with the accounting methodologies for the GHG emission activities and sources covered by this Protocol.

The Acknowledgements section of this chapter includes the names of TAC members and sponsors of the Protocol. ICLEI USA is grateful to our sponsors and for the hard work and dedication of the individuals who made this Protocol possible.

1.7 Relationship to Global Protocol for Community-Scale GHG Inventories

Version 1.0 of the US Community Protocol was developed concurrently and in parallel with the *Global Protocol for Community-Scale Greenhouse Gas Emissions (GPC) Pilot Version 1.0*, which was released in May 2012. The GPC was prepared by the C40 Cities Climate Leadership Group and ICLEI – Local Governments for Sustainability in collaboration with the World Resources Institute, World Bank, UNEP, and UN-HABITAT. The GPC is intended for use by local government authorities around the world for the purpose of accounting for and reporting on community GHG emissions through inventories. The GPC is available at https://ghgprotocol.org/greenhouse-gas-protocol-accounting-reporting-standard-cities.

This U.S. Community Protocol was developed to meet the specific needs of U.S. local governments within the communities they serve and represent. GHG accounting methods provided are based on U.S. best practices and available data sources that may not be applicable or in use outside the U.S. For this reason, some of the requirements and optional guidance contained in this Protocol differs from that included in the GPC. It is important to keep in mind that the methods illustrated in this protocol are **not incompatible** with the GPC and the two standards can be used concurrently. The USCP provides information on how to perform the calculations, whereas the GPC sets standards for disclosure. Various initiatives may have other reporting standards that follow different schemes for categorization of the results.

This Protocol includes guidance to help interested local governments also fulfill the requirements of the GPC (see Chapter 4). Both this Protocol and the GPC build upon previously published protocols and standards, including the International Local Government GHG Emissions Analysis Protocol (IEAP),[14] the International Standard for Determining Greenhouse Gas Emissions for

[14] ICLEI – Local Governments for Sustainability

Cities,[15] the GHG Protocol Standards,[16] the Baseline Emissions Inventory/Monitoring Emissions Inventory methodology,[17] and the Local Government Operations Protocol.[18] The US Community Protocol is unique in its acknowledgement of the porous boundaries of community scale accounting, the limited powers of government, and the collective responsibility of community members to address GHGs.

It should be noted that other protocols and associated processes have particular rules for certain terminology. For example, many international agreements use the term 'accounting' to refer to specific calculations around reporting on changes to a baseline. Readers should note that this protocol uses the term broadly to discuss activities around data collection, calculation, categorization, and report development.

1.8 Future Evolution

Reporting on GHG emissions at the community scale is an established, yet continuously evolving field. New ways of measuring and estimating the GHG emissions associated with community activities are rapidly developing. This is especially true of accounting methods that can help communities quantify and consider certain trans-boundary and life cycle GHG emissions associated with activities such as travel, use of energy, and consumption of goods and services. In addition, further development of quantification guidance methodologies is needed for certain types of GHG emission activities and sources not addressed in this version of the Protocol.

This Protocol is designed to evolve over time as methods for quantifying and reporting on GHG emissions evolve. ICLEI USA will continue to engage a Protocol Steering Committee and explore new partnerships to support the process of developing future editions of this document.

[15] United Nations Environment Program (UNEP), United Nations Human Settlements Program (UN-HABITAT), and the World Bank
[16] World Resources Institute (WRI) and World Business Council for Sustainable Development (WBCSD)
[17] The EU Covenant of Mayors Initiative (predecessor to the Global Covenant of Mayors)
[18] ICLEI USA, California Air Resources Board, California Climate Action Registry, The Climate Registry.

2. Step One: Conduct the Scoping Process

This chapter provides guidance to help local governments consider which GHG emissions sources and activities to include in their community GHG inventories. These considerations will be informed by the goals and capacity of each local government, and the stories it wishes to tell about GHG emissions associated with the community.

2.1 Overview of Selecting GHG Sources and Activities to Include

The first step in developing a Protocol-compliant inventory is to conduct a scoping process to select emission sources and activities that will be included in the inventory. This process should include reflection on the local government's reporting goals and capacity and on the list of potential emission sources and activities to be included.

This Protocol provides accounting guidance for the wide range of potential community emission sources and activities shown in Tables 2 and 3. In addition, local governments may choose to include other emission activities and sources for which this Protocol does not contain accounting guidance.

Local governments must include a minimum set of five Basic Emissions Generating Activities in their GHG emission inventories (described in section 2.2 below). Beyond these, local governments are strongly encouraged to include additional emission sources and activities as guided by their reporting goals.

Local governments may choose to develop community GHG inventory reports for many different reasons. In conducting the scoping process, local governments should consider their reporting goals and the optional "reporting frameworks" provided in this Protocol that are best suited to those goals (described in Section 2.3 below). Each of the reporting frameworks can be used to convey a particular story about GHG emissions associated with the community, generally involving different combinations of the emission sources and activities listed in Table 2. Using the reporting frameworks to first consider the stories you want to tell about GHG emissions associated with the community will guide your selection of emission sources and activities for which to collect data.

Local governments are strongly encouraged to report on all GHG emission sources and activities over which they have significant influence, as well as other activities of community interest, and emissions associated with consumption activities of community households. See section 2.3 for guidance on these reporting frameworks.

2.2 Required: Five Basic Emissions Generating Activities

This Protocol defines a minimum set of five Basic Emissions Generating Activities that must be included in all Protocol-compliant GHG inventory reports. The purposes of this requirement are to facilitate the process of assessing emission sources and activities over which local governments

commonly have influence, and to support shared learning and comparison on a common set of emissions across U.S. communities.

The criteria below were used to identify these required five basic GHG emissions generating activities:

- Local governments typically have significant influence over the emissions generating activity
- Data needed to estimate emissions is reasonably available
- Emissions associated with the activity tend to be significant in magnitude
- The activity is common across U.S. communities

Local governments must include emissions associated with the following five Basic Emissions Generating Activities, at minimum, in their emissions inventory reports:

1) **Use of Electricity by the Community** – Power plant emissions associated with generating electricity used within the jurisdictional boundary of the community, regardless of the location of the electricity generation facility.

   Rationale: Local governments can often influence electricity use in local buildings through local building codes, financial incentives, minimum regulatory requirements, technical assistance, and other programs.

2) **Use of Fuel in Residential and Commercial Stationary Combustion Equipment** – Combustion emissions associated with fuels used in residential and commercial stationary applications (e.g., natural gas used in boilers and furnaces) within the jurisdictional boundary of the community, excluding fuels used for production of electricity or district energy.

   Rationale: Local governments can often influence use of fuels in stationary combustion applications (e.g., furnaces) in local buildings through local building codes, financial incentives, minimum regulatory requirements, technical assistance, and other programs.

3) **On-Road Passenger and Freight Motor Vehicle Travel** – Emissions associated with transportation fuels used by on-road passenger and freight motor vehicles. Local governments may meet this requirement by reporting emissions associated with either: 1) Travel associated with origin and destination land uses in the community through a demand-based allocation of trips (preferred if available), or 2) Travel occurring within the jurisdictional boundary of the community. More detail on these methods is provided in Chapter 3 and Appendix D.

   Rationale: Local governments can influence transportation emissions through land use and urban design regulations and through transportation infrastructure investments.

4) **Use of Energy in Potable Water and Wastewater Treatment and Distribution** – Emissions associated with energy used in the treatment and delivery of potable water used in the community and in the collection and treatment of wastewater used in the community, regardless of the location of the water and wastewater infrastructure.[19]

[19] Energy use associated with water and wastewater infrastructure may also be partially or fully included in the use of purchased electricity and stationary combustion equipment. If the user wishes to sum the Basic Emissions Generating Activities, this double-counting should be identified and acknowledged. See Chapter 4 for guidance on addressing double counting in any aggregation of emissions numbers.

Rationale: Local governments can influence community water use through local building codes, promoting and/or providing incentives to foster conservation and efficiency, and other programs and services.

5) **Generation of Solid Waste by the Community** – End-of-life emissions (i.e., projected future methane emissions) associated with disposal of waste generated by members of the community during the analysis year, regardless of disposal location or method.

   Rationale: Local governments can influence the amount of solid waste generated and sent to various disposal methods through their administration of municipal solid waste, recycling and composting services.

Detailed GHG accounting methods are provided in the sector-specific Appendices (under separate cover) to this Protocol to help local governments obtain data and estimate GHG emissions associated with each of these activities.

2.3 Indicator Data

While the inventory process is mainly focused on the collection of data surrounding GHG generating activities and sources, the interpretation of that data often requires knowing the conditions and other pieces of context that contributed to performance levels. Communities interested in developing explanatory analysis of the changes between multiple inventories over time, such as with the Contribution Analysis method will need those additional data points in order to proceed.

In addition to data needed to calculate emissions, local governments should collect and report the indicator data listed below for the same year as the activity data of inventory. This data is needed to provide proper context for emissions and to understand changes in emissions over time. Having this data will allow local governments to complete a contribution analysis when future inventories are completed.

- Total community population included within jurisdiction boundary or represented in any transboundary data sets such as transportation
- Number of residential households served by utilities providing energy consumption data
- Local GDP per capita
- Square footage of commercial building space **or** total number of jobs served by utilities providing energy consumption data
-

2.4 Guidance on Selecting Additional Community GHG Sources and Activities

2.4.1 Recommended Reporting Frameworks

Local governments should consider their reporting goals and the optional reporting frameworks below that are best suited to achieving those goals when selecting additional emissions sources and activities to include in the inventory. Each of these reporting frameworks can be used to convey a particular story about GHG emissions associated with the community. The reporting frameworks include different combinations of the emission sources and activities listed in Table

2. Community GHG emissions can be presented through multiple reporting frameworks in a single inventory report.

Strongly Encouraged: Focus on Key Stories

Complete your GHG inventory report using one or more of the following reporting frameworks (in order of recommended priority):

1) **Local Government Significant Influence** – It is anticipated (but not required) that local governments will often choose to focus their community GHG inventories, as well as their reduction targets, climate action planning, and mitigation efforts, on emission sources and activities over which they have significant influence. This reporting framework emphasizes policy relevance, highlighting a set of emission sources and activities that the local government has the greatest opportunity to address. Explicitly identifying these emission sources and activities in contrast with others can help to establish expectations within the local government and the community regarding where the local government plans to focus its efforts. Guidance on identifying emission sources and activities subject to significant local government influence is provided in section 2.4.2. Consider including a brief discussion in your report explaining how the criteria provided in section 2.4.2 (e.g., ownership, operational control, regulatory authority, enforcement, budgetary) were used to determine which emission sources and activities should be included in and excluded from this set.

2) **Community-Wide Activities** – Local governments may want to report on other activities of potential community interest, regardless of whether or not the local government has significant influence over them. These include other emissions that result from activities such as the use of energy, materials, and services by all members of the community (see right side of Table 2). These emissions may be occurring within or outside of the community boundary. These include the required five Basic Emissions Generating Activities, and can include others such as the use of trans-boundary air and rail travel, the use of heat from district energy systems, and upstream impacts of fuels used for heat, electricity and transportation by the community. When used for comparison across communities, this framework is helpful in illustrating relative urban efficiencies.

3) **Household Consumption** – Local governments are also encouraged to report on GHG emissions associated with the consumption activities of community households, regardless of the ability of local government to influence those emissions. A household consumption report will help to illustrate the full, life cycle impacts of residents' activities and serve as an educational tool to encourage behavior change. It can also provide support for a range of actions from materials management and the reduction of wasted food to informing sustainable purchasing practices of governments, businesses, and households. Household consumption includes lifecycle emissions associated with household electricity use, household natural gas use, household personal vehicle transportation, household use of public transportation, household use of water and wastewater services, household production of garbage, and household use of materials and services. Aggregating these emissions will produce a household consumption-based total that may be used to educate your community's residents on the GHG impacts of

their consumption activities.[20] Additional details on this approach are provided in Appendix I.

Also Encouraged: Additional Reporting Frameworks

The local government may wish to expand the scope of its GHG inventory report through any or all of the following reporting frameworks:

4) **In-Boundary Sources** – Local governments may want to report on all of the emissions that originate from sources physically located within the community's geopolitical boundaries (see left side of Table 2). While doing so would be consistent with the standard for national greenhouse gas inventories, as well as emissions inventories for other air pollutants (e.g., air toxics) at the local scale, it provides a much less complete story of how the community contributes to climate change, as many community activities (e.g., use of electricity, materials) contribute to emissions from trans-boundary sources.

5) **Government Consumption** – Just as communities may tell the story of how consumption by households contributes to emissions, they may also want to explain how government consumption does the same. Note that "government" here refers to all levels of government located within the community – from federal and state facilities to school districts – and is not limited to just municipal or county operations. Additional detail on government consumption-based accounting is provided in Appendix I.

6) **Full Consumption-based Inventory** – Consumption is a root driver of both economic activity and emissions. A full consumption-based inventory always includes household and government consumption, and sometimes brings in one subcategory of business activities: capital and net inventory formation. Additional details on this approach are provided in Appendix I.

7) **Life Cycle Emissions of Community Businesses** – Businesses are an important part of most communities, and for many businesses, the emissions embedded in purchased goods and services far exceed the emissions associated with direct energy use. Communities may want to tell the story of all of the ways in which community businesses, as a whole, contribute to emissions. One method for estimating these emissions is currently under development; see Appendix I for details.

8) **Individual Industry Sectors** – Local governments may want to call out the contribution to emissions from individual industry sectors. For example, a tourism-dependent community might want to report on the emissions associated with the local tourism industry. This Protocol does not provide methods for estimating such emissions, but such methods may be developed.

9) **Create Your Own Story** – In addition to any of these reporting frameworks, local governments may identify other, additional stories they would like to tell.

2.4.2 Identifying Emissions Sources and Activities Subject to Significant Local Government Influence

[20] A full consumption based accounting approach covers the activities associated with local households, plus government and business capital investment. Additional details on consumption-based accounting and reporting are provided in Appendix I: Consumption-Based Emission Activities and Sources.

This section provides guidance on identifying sources and activities to include under the strongly recommended Significant Influence reporting framework, defined above in section 2.4.1. Every local government has the opportunity to use its jurisdictional authority and community influence to reduce GHG emissions associated with some subset of community sources and activities. Use the following criteria to identify which GHG emission sources and activities your local government has significant influence over. Affirmation of any one or more of these criteria indicates an emissions source or activity is subject to significant local government influence.

- Ownership – Does the local government own the GHG emission source and/or key related infrastructure*? Example: Does the local government own a landfill or municipal utility?*
- Operational Control – Does the local government have operational control over the GHG emission source and/or key related infrastructure? *Example: Does the local government operate the local public transit system?*
- Regulatory Authority – Does the local government have the statutory authority to enact regulatory requirements or incentives that could significantly impact the emission generating activity or source, even if it chooses not to exercise such authority? *Example: Can the local government reduce combustion emissions associated with fuels used by off-road surface vehicles and mobile equipment (e.g., construction equipment, lawn mowers) operating within the community boundary?*
- Enforcement – Is the local government the primary responsible party for enforcing regulations that could significantly impact the emission generating activity or its associated GHG emission source? *Example: Does the local government enforce building codes, dedicated lanes for transit, restrictions on the use of illegal refrigerants, or the maintenance of septic systems?*
- Budgetary – Does the local government exercise budgetary authority over the GHG emission source or have monetary influence over the community activity? *Example: Does the local government have budgetary authority over local public transit services?*

2.4.3 Independent Consumption-Based GHG Accounting Approaches

A few of the reporting frameworks described in section 2.4.1 involve the use of a separate accounting approach for communities interested in estimating "consumption-based" emissions. Consumption-based accounting is fundamentally about the activity of consumption. These consumption activities, although separate from the emission generating sources that make these activities possible, cause emissions to be generated from a vast number of different sources. Consumption-based accounting is different from accounting for GHG emission sources and activities associated with the whole community (residents, governments, and businesses together) in three key ways:

- The GHG emission *sources* associated with consumption can cross all sectors and geographies and have the potential to lead to significant double counting with sources and activities in Table 2. For example, consumption of cookies by households result in emissions at the cookie factory, as well as retail, wholesale and freight operations, as well as the suppliers to the cookie factory (e.g., flour mills, chocolate manufacturers, packaging manufacturers), their suppliers (wheat farms, dairies, paper and pulp mills), their suppliers (fertilizer producers, veterinarians, tree farms), and so on. If any of these sources are located in the community, or contribute to activities in the community, double counting

may occur. Consumption based emissions may also be counted in other accounting methods, so care needs to be taken to report consumption-based emissions in a manner that is clear and independent of reporting of emissions associated with other activities outlined in Table 2.

- The *activities* of consumption-based accounting in Table 3 also have complex and significant – yet incomplete – overlap with the activities in Table 2. For example, household consumption includes the emissions associated with household electricity use, household natural gas use, household personal vehicle transportation, household use of public transportation, household use of water and wastewater services, household production of garbage, and household use of materials, each of which are included in community-wide totals (not just households) in Table 2.

See Appendix I for further guidance on consumption-based accounting.

2.4.4 Other Considerations in Selecting GHG Emission Sources and Activities

Local governments should consider other criteria as well in selecting emission sources and activities from Table 2 to include in their emission inventories. For example, for each emissions source or activity, consider factors such as:

- Community Interest – Is the community interested in receiving information about emissions associated with particular sources or activities (e.g., large industrial facilities operating in the community, agricultural livestock in a rural community)?
- Magnitude of Emissions – Is the magnitude of emissions associated with the source or activity likely to be large?
- Accuracy of Emissions Estimation – Is it possible to estimate emissions associated with the source or activity with sufficient accuracy?
- Reproducibility of Data and Estimation Methods – Is the data needed for estimation updated at a regular frequency? Will it be possible to obtain needed data and reproduce emissions estimates for the source or activity in the same manner in the future for the purpose of confirmation or comparison?
- Level of Effort Required – How difficult will it be to obtain the data and perform the calculations needed to estimate emissions associated with the source or activity?
- Reflection of Progress – How valuable will an estimate of emissions associated with the source or activity be as a tool for reflecting GHG reduction progress created by local mitigation measures?

When in doubt, the GHG Accounting and Reporting Principles outlined in Section 1.5 should also be used to guide consideration of which GHG emission sources and activities to include in your community GHG inventory.

In some situations, the Accounting and Reporting Principles may conflict as you consider certain emission sources or activities, requiring the use of your best judgment. For example, the principle of completeness encourages including as many emission sources and activities as possible in your inventory. In contrast, the principle of accuracy emphasizes the need to ensure a reasonable level of accuracy in your emissions estimates. It is possible to encounter situations in which, from a

practical standpoint, only very rough assumptions can be made about the magnitude of certain emission sources or activities, resulting in questionable accuracy for any emissions estimation. Judgment must be used as to whether these estimates are appropriate for inclusion in the inventory. It is best practice to include notes explaining any concerns regarding accuracy of emissions estimates included in your inventory, as well as explanations for why sources or activities have been excluded from the inventory.

3. Step Two: Perform Emissions Calculations

This chapter provides an overview of GHG emissions accounting guidance that will help local governments identify data needs, obtain data, and perform calculations to quantify GHG emission sources and activities.

3.1 Introduction to Inventory Accounting Guidance

The second step in developing a Protocol-compliant GHG inventory is to perform emissions calculations to develop the community GHG inventory. This step involves identifying data needed to quantify the emission sources and activities, gathering data from data providers, performing calculations, and storing the input and emissions data.

The purpose of this chapter and the Detailed Sector Accounting Guidance Appendices are to guide local governments on how to account for GHG emissions associated with their communities, including in-boundary, trans-boundary, and life cycle emission sources and activities. Guidance is provided to help local governments:

- identify data needs and estimation methods;
- engage data providers to obtain data;
- perform calculations; and
- consider issues such as double counting potential.

The Detailed Sector Accounting Guidance Appendices are organized around the following community sectors, or categories of GHG emissions activities or sources:

- ***Appendix C:*** **Built Environment Emission Activities and Sources**
- ***Appendix D:*** **Transportation and Other Mobile Emission Activities and Sources**
- ***Appendix E:*** **Solid Waste Emission Activities and Sources**
- ***Appendix F:*** **Wastewater and Water Emission Activities and Sources**
- ***Appendix G:*** **Agricultural Livestock Emission Activities and Sources**
- ***Appendix H:*** **Emissions Associated with the Community's Use of Materials and Services: Accounting for Trans-boundary Community-Wide Supply-Chains**
- ***Appendix I:*** **Consumption-Based Emission Activities and Sources**
- ***Appendix J:*** **Forest Land and Trees Outside Forests**

For each GHG emission source, accounting methodologies are provided to assist local governments in measuring or estimating GHG emissions associated with community activities and sources. Protocol accounting methods must be used in Protocol-compliant inventories except where the user identifies and documents another method that is likely to better satisfy the Protocol accounting principles in Chapter 1.

For some emission sources and activities addressed in this Protocol, multiple accounting methods are provided, often varying in accuracy, rigor, reproducibility, data quality and/or level of effort involved. Recommended accounting methods are indicated and must be followed whenever possible for an inventory to be considered Protocol-compliant. When alternate methods are

followed, an explanation should be provided for why the recommended method was not followed.

Additional emission sources associated with community activities exist for which accounting guidance is not provided in this Protocol, generally due to a lack of data availability or recognized accounting methods (e.g., emissions associated with certain agriculture and land use activities). Future iterations of this Protocol may provide accounting guidance for additional emission sources (or sinks) as methods evolve.

Likewise, future accounting methods may require adjusting emission factors as GHG attributes associated with emissions generating activities are understood in new ways (e.g., the role of black carbon, which is generally ignored by current accounting methods). Local governments should retain all accounting input data (not just calculated GHG emission numbers) to facilitate future adjustments to completed GHG inventories in order to enable appropriate comparison over time.

Below are brief summaries of each of the Detailed Sector Accounting Guidance Appendices. These are followed by Tables 6 and 7, each of which offer expanded definitions of the GHG emission sources and activities outlined in Tables 2 and 3 in Chapter 1.

3.2 Summaries of Detailed Sector Accounting Guidance Appendices

This section provides an overview of the detailed accounting methods found in Appendices C-I, for emissions from the built environment; transportation and other mobile sources; solid waste; wastewater and water; agricultural livestock; materials and services supply-chain; and consumption-based approaches. These methods account for a mix of in-boundary, trans-boundary, and life cycle emissions, for all emissions sources and activities described in Tables 2 and 3 in Chapter 1.

While a few of the provided accounting methods rely on direct measurement of GHG emissions at the source or refer to existing emissions inventories, the majority of methods rely on calculations based on activity data, emissions factors, and conversion to CO_2-equivalent (CO_2e) units using global warming potentials (GWP). Activity data is generated either through observation, user reporting, or modeling of various activities in the community, such as vehicle miles travelled and electricity consumed, and is available from a variety of public and private sector entities. Activity data is then multiplied by emissions factors that reflect the quantity of various greenhouse gases emitted with each unit of activity. Finally, emissions are multiplied by global warming potentials, which are metrics used to convert the quantity of emissions from various greenhouse gases into a standard unit (metric tons CO_2e) based on the strength of their effect on global warming.

There are a number of circumstances where individual communities may wish to use different GWP values, including maintain consistency with past inventories, alignment with neighboring communities or higher levels of government, or in order to emphasize appropriate concern towards short-lived climate pollutants. For these reasons, this Protocol does not prescribe the use of any particular set of GWP values. What is required is transparency over which selection has been made and where possible reporting of individual gases without adjustments for global warming potential as well as CO_2 equivalents. In keeping with the GHG principle of consistency,

care should be taken to not use GWP values interchangeably within a single assessment or for individual sectors or calculations. Special attention should be made to the use of any summary emissions factors that express emissions intensity in terms of CO_2 equivalent. Examples used throughout this protocol reference the 100 year horizon values published in the Intergovernmental Panel on Climate Change (IPCC) Second Assessment Report, which were the most commonly used GWPs at the original publication of this Protocol. These values are likely to continue to evolve with the evolution of climate science and communities are likely to need to update and recalculate previous inventories to ensure consistent comparisons of GHGs over time. It is best practice to record and report emission factors and GWP values used for all calculations to enable appropriate comparison over time.

As noted previously, activity data may either be measured or modeled. When possible, it is generally preferable to use measured activity data. When it is necessary to used modeled activity data (as is usually the case with on-road VMT, for example), it is important to be aware of the parameters and limitations of the model. One important consideration is the timescale for changes in model parameters and the timescale on which the model may be updated or re-calibrated. If these timescales are more than a few years, then the modeled activity data may be useful to establish relative importance of the emissions source, but will not be of much use in monitoring emissions performance.

Most modeled activity data will not be able to show the effects of local emissions reduction activities, unless those activities are directly incorporated into the model. For example, travel demand models generate VMT based on land use patterns, so local actions that change land use will be reflected in the model output. On the other hand, other local actions such as educational campaigns to encourage biking and walking, would not show up in the model, unless the model is recalibrated with new traffic counts made after program implementation. These kind of considerations are important for not only how the results of a single inventory should be interpreted but also how well a particular data source can showcase the impact of local reduction measures.

3.2.1 Built Environment Accounting Methods

The built environment includes the human-made surroundings that provide the living and working spaces for human activity, ranging in scale from personal shelter and buildings to neighborhoods and cities that include supporting infrastructure, such as energy networks. GHG emissions attributed to the built environment include those from government, residential, commercial and industrial buildings; the operational processes and human activities associated with those buildings; and electric vehicle use. These emissions are limited to energy used within buildings, refrigerants, fire suppressants, and industrial processes.

Built environment emissions are attributed to the following sources and activities:

- stationary fuel combustion
- electricity use
- district heating and cooling energy use
- electric power transmission and distribution losses
- life cycle (i.e. “upstream”) emissions from energy use

- electric power production
- refrigerant and fire suppressant leakage
- industrial process emissions

Energy-related Emissions. Generally, recommended methods for measuring emissions from energy used in buildings rely on activity data for fuels combusted, electricity used, or use of other forms of energy. These data are multiplied by emissions factors for each energy source. Third-party verified utility-specific emissions factors are recommended. However, if utility-specific emission factors are not available, US EPA eGRID regional emission factors may be used. In addition to emissions from sources and activities involving the combustion of fuels within a community, methods are provided for life cycle emissions from energy use that rely on emissions factors from the National Renewable Energy Laboratory (NREL) Fuels and Energy Pre-combustion Life Cycle Inventory (LCI) database.

Emissions from Refrigerants and Fire Suppressants. Obtaining accurate data for a community's emissions from refrigerant and fire suppressant leakage may be challenging. At the community scale, such information will be difficult to collect from all sources as there are potentially thousands of individual applications where refrigerants or fire suppressants may be used. To estimate your community's refrigerant leakage and fire suppressants GHG emissions, Protocol users are advised to use the general methodology outlined by the US Environmental Protection Agency with interpretation and implementation provided through the California Air Resources Board's Rulemaking to Consider the Adoption of a Proposed Regulation for the Management of High Global Warming Potential Refrigerants for Stationary Sources.

Industrial Process and Product Emissions. The recommended method for accounting for industrial process emissions is to obtain data from previously conducted emissions inventories for large facilities. Many facilities emitting more than 25,000 $MTCO_2e$ are required to report their emissions to EPA under its Mandatory Reporting Rule (MRR), and these reports can be obtained for facilities in your community. In addition, many states have their own state reporting requirements and some require reporting from smaller sources (such as facilities emitting as little as 2,500 MTCO2e in Oregon); these reports can also be obtained for facilities in your community. However, obtaining necessary data to fully account for industrial process emissions is limited due to privacy laws protecting many companies disclosing and reporting process emissions data if operating under the minimum threshold of 25,000 $MTCO_2e$ per year.

For detailed accounting guidance, please refer to Appendix C.

3.2.2 Transportation and Other Mobile Sources Accounting Methods

The transportation sector comprises emissions associated with the movement of people and goods, as well as service vehicles. This movement may be by road, rail, air, or water. Combustion of fuel in vehicle engines produces CO_2, N_20, and CH_4 emissions. In some cases, particularly in transit, vehicles are powered by electricity and produce emissions from electricity generation. Accounting methods are provided in Appendix D for emissions from passenger vehicles, freight rail, transit, aviation, marine vessels, and off-road equipment. A method is also provided for estimating life cycle emissions from fuels.

As a source over which local governments have significant influence, passenger vehicle emissions will be most commonly accounted for in emissions inventories. The recommended method for passenger vehicles requires modeling of travel demand (vehicle miles travelled) induced by land uses in the community, assigning trips to the community when their origin or destination is located inside the jurisdictional boundaries, even if the trip extends outside the boundaries. The alternate method allows for accounting based on trips occurring only on road segments within the jurisdictional boundaries, even when those trips may neither begin or end in the community ("pass-through" traffic).

For detailed accounting guidance, please refer to Appendix D.

3.2.3 Solid Waste Accounting Methods

Greenhouse gas (GHG) emissions result from management and decay of solid waste. Accounting methods address both emissions arising from solid waste *generated* by a community (regardless of where it is disposed of) as well as emissions arising from solid waste *disposed* of inside a community's boundaries (regardless of where it was generated). Appendix E provides accounting methods for the following solid waste emissions activities:

- Combustion of fuel used to transport and process waste
- Combustion of solid waste in incinerators or waste-to-energy facilities
- Decomposition of biologic solid waste in landfills

For both landfills and waste-to-energy facilities, recommended methods direct the user to obtain emissions data from EPA's Mandatory Reporting Rule databases if the facilities are subject to the Rule. If they are not, landfill emissions can be accounted for using a first order of decay model under an alternate method. An alternate method is also provided for waste-to-energy facilities, allowing for calculations based on EPA emissions factors and defaults for solid waste heat content and share of biologic waste.

For detailed accounting guidance, please refer to Appendix E.

Emissions Associated with Recycling and Composting Diversion Programs

Recycling and composting diversion programs are very important tools for reducing GHG emissions in the community. Protocol-compliant inventories should acknowledge the benefits of programs that lower waste volumes than they would be otherwise. Recycling and composting diversion programs affect a community's emissions in two ways: by reducing landfill or combustion emissions, and by reducing upstream emissions from materials manufacturing when recycled materials displace virgin feedstocks. The reduced emissions from landfills or waste combustion will be reflected in the gross emissions totals for these sources using the Protocol's solid waste accounting methods. However, upstream emissions reductions from materials manufacturing, which are far more significant than landfill/combustion emissions reductions, are more problematic. These emissions would be partially captured through application of methods pertaining to life cycle emissions analysis in Appendix H and Appendix I, but the emissions reduction benefits will not be explicitly quantified and will be small compared to the aggregate emissions from all materials and services used or consumed by the community.

To address the clear need to account for the GHG benefits of recycling and composting programs, ICLEI has published an accounting standard developed by the Solid Waste TAC for estimating the specific emissions ***reductions*** from recycling and composting (rather than the gross emissions totals that are the subject of this GHG inventory Protocol). The ICLEI Recycling and Composting Protocol is available at www.icleiusa.org.

3.2.4 Wastewater and Water Accounting Methods

Wastewater treatment can create a unique set of process, stationary, and fugitive greenhouse gas emissions. Methane (CH_4) is produced when microorganisms degrade the soluble organic material in wastewater under anaerobic conditions. Nitrous Oxide (N_2O) is an intermediary product of both conventional treatment and specialized biologically mediated processes to remove excess nitrogen in wastewater. A fraction of the nitrogen discharged into natural waters may undergo similar processes and also produce N_2O. Carbon Dioxide (CO_2) emissions from wastewater treatment are distinguished as either biogenic or fossil fuel based.

Calculation-based methodologies are provided in Appendix F for major sources of wastewater emissions. For any source, these methodologies may be substituted with on-site source tests using methodologies drawn from approved regulatory methods. On-site emissions monitoring should be more representative of the emissions than the generic emission factors in the detailed accounting methods and thus are preferred. Appendix F provides GHG accounting guidance for the following common wastewater treatment processes, as well as others.

Conventional Treatment. For purposes of this Protocol, conventional treatment refers to any centralized system other than a lagoon that degrades the dissolved organics in wastewater under aerobic conditions. These systems may also employ anaerobic digestion for solids processing, in which naturally occurring microorganisms degrade residual organics in the absence of atmospheric oxygen to produce a combustible, renewable gas consisting of roughly 65% CH_4 and 35% CO_2. Recommended methods offer calculations for digester gas emissions based on population served, quantity of any digester gas produced, and the fraction of CH_4 in the digester gas. If the fraction of CH_4 is not known, an alternative method substitutes the BTU content of the digester gas.

Nitrification and Denitrification. Some centralized wastewater treatment systems include additional treatment to either oxidize nitrogenous wastes to oxidized forms of nitrogen or remove nitrogen entirely. This process may be assisted by the oxidation of a supplemental form of carbon like methanol that results in the release of fossil-based carbon as CO_2. These systems may employ digesters to manage the process solids. A recommended method utilizes population served to estimate N_2O from this activity.

Lagoons. Lagoons are shallow earthen basins varying in depth from 2 to 5 meters that use some combination of physical, chemical, and/or biological treatment processes that renders the wastewater more acceptable for discharge to the environment. Some are operated with mechanical aeration while others are allowed to remain stagnant and may have periods of anaerobic activity where CH_4 may be produced. The recommended method offers a calculation utilizing data on the Biochemical Oxygen Demand (BOD_5) load of the lagoon; BOD_5 is the amount of dissolved oxygen consumed in five days of biological decomposition. Users should be able to obtain this value from the agency that oversees the lagoon. If this data is not available, an alternate method provides a calculation based on population served by the facility.

Septic Tanks. Roughly one in five households in the United States depends on an individual septic (onsite) system to treat wastewater. Septic tanks typically contain underground stagnant and unaerated tank(s) where the treatment occurs by physical settling and biological activity. Emissions are mainly CH_4 with very little N_2O generated. The recommended method offers a

calculation utilizing data on the Biochemical Oxygen Demand (BOD_5) load of the septic systems. An alternate method is based on population served.

Community-generated Wastewater. Every community generates wastewater, but not every community has its own treatment system. To account for wastewater treatment emissions occurring at a facility outside of the jurisdictional boundary but as a result of wastewater generated in the community, Appendix F offers a simple methodology for attributing these emissions based on the number of people served by the treatment facility.

Energy-related emissions associated with water delivery and treatment. The use of water by a community's residents and businesses can have significant GHG implications depending on the source of water delivered, treatment methods, distances and topography traversed in conveyance, and the treatment processes that occur before and after the end-use phase. Incorporating the relationship between water consumption and energy consumption in a GHG inventory allows a community to use water conservation measures as a GHG emissions reduction strategy.

For detailed accounting guidance, please refer to Appendix F.

3.2.5 Agricultural Livestock Accounting Methods

Agricultural livestock activities can be a significant source of greenhouse gas emissions for some communities. Many different types of livestock activities can produce emissions. Appendix G contains detailed accounting guidance for agricultural livestock emission sources for which there are well-established quantification methods and for which mitigation measures are available to reduce emissions. Quantification methods and emission factors were taken from the US EPA. Accounting methods are provided for emissions from enteric fermentation and from manure management.

Enteric fermentation. Enteric fermentation is the process of microbial fermentation through which methane is produced during animal digestion. Ruminants like cows and goats produce higher levels of methane because of their unique digestive systems. Enteric fermentation is one of the largest methane contributors; in the United States, CH_4 emissions from enteric fermentation represent about 25 percent of total CH_4 emissions from anthropogenic activities. A recommended method is provided that derives emissions from information on the population and default emissions factors for several animal types.

Manure management. Manure, the natural waste byproduct of livestock, creates both methane (CH_4) and nitrous oxide (N_2O) gas emissions as it biodegrades. Manure management refers to a system that stabilizes or stores livestock manure, and different management systems yield varying quantities of GHG emissions. Several methods are offered in Appendix G that calculate emissions using default factors and local data collected on animal populations under different manure management systems.

For detailed accounting guidance, please refer to Appendix G.

3.2.6 Forest Land and Trees Outside Forest GHG Estimation Methods

How lands are managed can result in significant GHGs exchanged between the atmosphere and land. GHGs from land use differ from those of energy, industrial processes, and waste—most prominently, land management can lead to both emissions *and removals* of CO_2 from the atmosphere. In the United States, land use is a net sink with greater CO_2 removals than emissions, mostly into forests and trees. Currently, the Appendix on land use includes detailed GHG estimation guidance for these two components of land (forest land and "trees outside forest"), as well as transitions between forest and nonforest land uses, which have the largest impacts of the land sector on the U.S. GHG inventory.

Forest Land. The protection, management and/or use of forest lands have an impact on terrestrial carbon stocks. Forests play an important role in the global carbon cycle by converting carbon dioxide during photosynthesis and into stored carbon as they grow (removal of CO2 from the atmosphere) and producing oxygen as a by-product. Forest lands in the United States currently remove over 700 million tCO_2 annually[21]—offsetting nearly 10% of U.S. gross emissions. Significant emissions also occur when forest land is disturbed by events such as wildfire, harvesting, or conversion to, e.g. settlements or cropland. Measuring GHGs from forest land requires data on forest area and its changes over time, as well as the average carbon stock (and changes in C stock over time) in forest lands. Several methods for estimating GHGs from forest land are provided in Appendix J. The US government (in particular, NASA, USGS and the US Forest Service) provides national-, state-, and county-scale data that can be used by communities, in absence of having finer scale community-specific data, to estimate GHGs from forest land.

Trees Outside Forests. Beyond forest land, trees may also be present in other types of lands within the community boundary (e.g. cropland, settlement, grassland, wetland, other land). Including the tree component of these lands is a preliminary step towards covering non-forest land categories more comprehensively in the future. Urban trees are found in the "settlement" category of national scale GHG inventories and are the next largest component from land use, after forest land, to the US GHG Inventory, sequestering over 120 million tCO_2 per year. Removals occur when trees are maintained or planted, while emissions occur if trees are lost due to, e.g. expanding urban boundaries, mortality, or simply cut down for other reasons. A simplified method for estimating GHGs from trees is provided in Appendix J and requires a tree inventory or information on tree canopy over time and estimates of the average carbon stock (and changes in C stock over time) in trees. The US Forest service provides default values for C stocks (and changes) that can be used by communities.

For detailed GHG estimation guidance on forest land and trees outside forests, please refer to Appendix J.

3.2.7 Life Cycle Emissions Methods

Life cycle analysis of GHG emissions is an emerging practice that accounts for emissions from an activity or source from "cradle to grave." This may mean estimating emissions upstream of the

[21] Source: US EPA, 2019 United States GHG Inventory, Chapter 6 (Land Use, Land-Use Change, and Forestry); the figure includes "Forest land remaining forest land" and "Land converted to forest land" (but not emissions from Forest Lands converted to other lands (e.g. cropland, grasslands, settlement).

traditional point of measurement—taking into account the raw materials used in making a product or the energy used to transport the product to a local market, for example—as well as estimating downstream emissions resulting from consumption and disposal.

Guidance on accounting for life cycle emissions is found in several locations in the Protocol appendices. For energy in the built environment, Appendix C offers methods that look beyond the direct, in-boundary emissions from fuel combustion to the upstream emissions associated with producing and distributing the fuel, as well as indirect emissions from electricity use. Similarly, Appendix D provides guidance for estimating upstream emissions from transportation fuels used in or by the community.

A more comprehensive life cycle analysis would address materials and services beyond fuel combustion. At the time version 1.0 of this Protocol was written, life cycle accounting of greenhouse gas emissions at the community scale is a relatively young field. Methods are still being tested, evaluated and compared, and "best practices" have yet to emerge. As such, this Protocol does not recommend one method over another, but lays out two broad approaches to comprehensive life cycle analysis, in Appendices H and I.

Appendix H outlines a "Trans-boundary Community-Wide Supply-Chain" approach for estimating upstream emissions from the use of individual commodities by all users in the community. It focuses on upstream emissions from food and cement, but also includes emissions factors for other materials, drawn from the EPA WARM model. Generally, this type of supply-chain analysis relies on a function of materials flow—reflected either in the quantity or dollar amount of materials used—and commodity-specific emissions factors:

$$\textit{GHG Emissions } (CO_2e) = \textit{Material or Service Flow (M)} \times \textit{Emission Factor (EF)}$$

While Appendix H focuses on specific materials used by all segments of the community, Appendix I offers broad considerations around a "Consumption-Based Analysis" for all materials and services consumed by specific segments of the community, namely households and governments. The distinction is important. The Appendix H method includes materials that may be used by businesses in producing goods for export, while the consumption-based approach described in Appendix I is limited to the "final consumption" of goods in the community—that is, all upstream emissions associated with a particular commodity are attributed to the final consumer in the community. Table 5 summarizes the differences between the two life cycle approaches.

For detailed accounting guidance, please refer to Appendices H and I.

Table 5. Major Differences Between Key Trans-boundary Community-wide Supply-Chains and Household and Government Supply-Chains

	Trans-boundary Community-Wide Supply-Chains	Household and Government Supply-Chains (Consumption-Based Accounting)
Community members covered	All users of materials and services in a community, e.g., households, government, businesses, and industries.	Households and government[22]
Commodities covered	Typically the evaluation is performed on an individual commodity basis. Food and cement are two common examples.	Typically performed (using macroeconomic models) for the entire basket of consumption, e.g., all materials and services (including electricity and fuels) consumed. Local energy use (electricity, natural gas, fuels) by households and government are already accounted for in previous sections of this Protocol.

[22] Household and government supply-chains are sometimes supplemented with estimates of business capital/inventory formation. See Appendix I: Consumption-Based Emission Activities and Sources for details.

3.3 Expanded GHG Emission Sources and Activities Definitions

Tables 6 and 7 (below) offer expanded definitions of each of the GHG emission sources and activities outlined in Tables 2 and 3 in Chapter 1.

Table 6. Expanded Definitions of Potential Community-Wide GHG Emission Sources and Activities

GHG Emissions Sources	Activities Resulting in GHG Emissions
Built Environment	
Use of fuel in residential and commercial stationary combustion equipment Combustion emissions associated with fuels used in stationary applications within the jurisdictional boundary of the community, excluding fuels used for production of electricity or district energy. Methods are provided for both utility-delivered and non-utility-delivered fuels. It may be desirable to organize data into subsets such as: residential, commercial, industrial.	**Use of fuel in residential and commercial stationary combustion equipment** Combustion emissions associated with fuels used in stationary applications (e.g., use of furnaces and boilers with natural gas combustion, diesel generators) within the jurisdictional boundary of the community, excluding fuels used for production of electricity or district energy. Methods are provided for both utility-delivered and non-utility-delivered fuels. It may be desirable to organize data into subsets such as: residential, commercial, industrial.
Power generation in the community Combustion emissions associated with generation of electricity at facilities located within the community boundary, regardless of where that electricity is used.	**Use of electricity by the community** Power plant emissions associated with generating electricity used within the jurisdictional boundary of the community, regardless of location of the electricity generation facility. It may be desirable to organize data into subsets such as: residential, commercial, industrial. Emissions associated with the use of purchased electricity should include delineation of electricity used in stationary applications vs. transportation vehicles to the extent possible.
District heating or cooling facilities in the community Combustion emissions associated with district energy generation of steam heat or cooling at facilities located within the community boundary, regardless of where that district energy is used.	**Use of district heating or cooling by the community** Central plant emissions associated with generating central steam heat or cooling used within the jurisdictional boundary of the community, regardless of location of the generation facility. It may be desirable to organize data into subsets such as: residential, commercial, industrial.
Industrial process emissions in the community Non-combustion industrial process and product use (IPPU) emissions occurring within the jurisdictional boundary of the community (e.g., production of cement), excluding those from electric power plants, water and wastewater utilities, and wastewater facilities.	
Refrigerant leakage in the community Emissions from refrigerant leakage (e.g., SF_6 from electricity transmission and distribution; refrigerants from HVAC, supermarkets, warehouses; fire suppressants).	

Table 6. Expanded Definitions (Continued)

GHG Emissions Sources	Activities Resulting in GHG Emissions
Transportation and Other Mobile Sources [i, ii, iii, iv]	
On-road passenger vehicles operating within the community boundary Combustion emissions from passenger motor vehicle travel occurring within the jurisdictional boundary of the community.	**On-road passenger vehicle travel associated with community land uses** Combustion emissions from transportation fuels used by passenger motor vehicles in trips associated with the community identified through a demand-based allocation of motor vehicle travel. This method includes the length of all trips with origin and destination within the community boundary, and the length of trans-boundary trips of either origin or destination within the community boundary (choose either inbound or outbound trips), and excludes pass-through travel. Note: Data needed for this method may not be available in all communities. This method should be included if data is available.
On-road freight and service vehicles operating within the community boundary Combustion emissions from freight and service motor vehicle travel occurring within the jurisdictional boundary of the community.	**On-road freight and service vehicle travel associated with community land uses** Combustion emissions from transportation fuels used by freight and service motor vehicles in trips associated with the community identified through a demand-based allocation of motor vehicle travel. This method includes the length of all trips with origin and destination within the community boundary, and the length of trans-boundary trips of either origin or destination within the community boundary (choose either inbound or outbound trips), and excludes pass-through travel. Note: Data needed for this method may not be available in all communities. This method should be included if data is available.
On-road transit vehicles operating within the community boundary Combustion emissions from transit motor vehicle travel occurring within the jurisdictional boundary of the community.	
Transit rail vehicles operating within the community boundary Emissions associated with the portions of local rail transit that occur within the community boundary. Data may not be available.	**Use of transit rail travel by the community** Emissions associated with rail travel undertaken by community members in in-boundary and trans-boundary trips. Data may not be available.
Inter-city passenger rail vehicles operating within the community boundary Emissions associated with the portions of inter-city passenger rail travel that occur within the community boundary.	
Freight rail vehicles operating within the community boundary Emissions associated with the portions of freight rail travel that occur within the community boundary.	

[i] Community refers to residents, businesses, industries, and government co-located within a defined jurisdiction. Across each mode, travel by members of the community often involves crossing the community boundary with a portion of travel occurring outside the community. Quantifying emissions associated with the use of travel by the community generally involves estimating emissions associated with the entire length of in-boundary and trans-boundary trips, and allocating a portion of those emissions to the community for which emissions are being reported. Further detail is provided in Chapter 3.

[ii] Vessels operating within the community boundary include docked or idling vessels.

[iii] Emissions associated with use of travel by the community include energy used while vehicles are docked or charging.

[iv] Some communities with transportation hubs or ports may be interested in tracking emissions associated with fuel loaded into aviation, marine, or rail vessels departing from those hubs or ports. These vessels often transport people and goods associated larger geographic regions, and often most of the fuel loaded into them is combusted outside the community boundary. These emissions are not included in Table 6 for these reasons, but local governments may choose to report on them in addition to the GHG sources and activities listed in Table 6.

Table 6. Expanded Definitions (Continued)

GHG Emissions Sources	Activities Resulting in GHG Emissions
Transportation and Other Mobile Sources (Continued)	
Marine vessels operating within the community boundary Emissions associated with the portions of marine travel that occur within the community boundary. It may be desirable to categorize data into subsets such as passenger travel and freight transport.	**Use of ferries by the community** Emissions associated with ferry travel undertaken by community members for in-boundary and trans-boundary trips. Data may not be available.
Off-road surface vehicles and other mobile equipment operating within the community boundary Combustion emissions associated with fuels used by off-road surface vehicles and mobile equipment (e.g., construction equipment, lawn mowers) operating within the community boundary. Ground support vehicles at general aviation and military airports located within the community boundary should be presented as a subset if applicable.	
	Use of air travel by the community Emissions associated with air travel by passengers originating from or traveling to the community.

Table 6. Expanded Definitions (Continued)

GHG Emissions Sources	Activities Resulting in GHG Emissions
Solid Waste	
Operation of solid waste disposal facilities in the community Analysis year emissions associated with operation of solid waste disposal facilities located within the community boundary, regardless of the territory from which those disposal facilities receive waste. Methods are provided to quantify emissions associated with several types and aspects of solid waste disposal facilities: *1)* **Emissions from landfill** – Emissions of methane directly from landfills and in combustion of landfill gas. *2)* **Emissions from incineration** – Emissions from incineration process. *3)* **Emissions from composting** – Emissions of methane from compost facilities. *4)* **Process emissions associated with landfilling** – Emissions from landfill equipment and processes. (Note: this is both a source and an activity.) *5)* **Collection of solid waste** – Emissions from collection of waste. (Note: collection is both a source and an activity.) It may be possible to differentiate between emissions from in-boundary community waste vs. waste from other communities	**Generation and disposal of solid waste by the community** *6)* **Process emissions associated with landfilling** – Emissions from landfill equipment and processes. (Note: this is both a source and an activity.) *7)* **Collection of solid waste** – Emissions from collection of waste. (Note: collection is both a source and an activity.) *8)* **Transportation of solid waste** – Emissions from long-haul transporting of waste.
Wastewater and Water	
Operation of water delivery facilities in the community Emissions associated with any water delivery facilities and infrastructure located within the community boundary, regardless of the territory served by that infrastructure.	**Use of energy associated with use of potable water by the community** Emissions associated with energy used in delivery of potable water used within the jurisdictional boundary of the community, regardless of the location of the water delivery infrastructure.

Table 6. Expanded Definitions (Continued)

GHG Emissions Sources	Activities Resulting in GHG Emissions
Wastewater and Water (Continued)	
	Use of energy associated with generation of wastewater by the community Emissions associated with energy used in treatment of wastewater generated within the jurisdictional boundary of the community, regardless of the location of the wastewater treatment infrastructure.
Process emissions from operation of wastewater treatment facilities located in the community Emissions associated with operation of wastewater treatment facilities located within the community boundary. Methods are provided to quantify emissions associated with several aspects of wastewater treatment facilities. Custom combinations of these will be used to quantify GHG emissions associated operation of any given wastewater treatment facility based on local operating conditions: *1)* **Emissions from Combustion of Digester Gas** – Emissions of methane, N_2O and CO_2 from combustion of digester gas *2)* **Emissions from Combustion of Biosolids and Sludges** – Methane and N_2O emissions from combustion of biosolids and sludges *3)* **Emissions from Wastewater Treatment Lagoons** – Emissions of methane produced during treatment process at wastewater treatment lagoons *4)* **Emissions from Wastewater Treatment Plants with Nitrification or Denitrification** – Emissions of N_2O during treatment process at wastewater treatment plants operating with nitrification or denitrification *5)* **Emissions from Wastewater Treatment Plants without Nitrification or Denitrification** – Emissions of N_2O during treatment process at wastewater treatment plants operating without nitrification or denitrification *6)* **Emissions from Biological Nitrogen Removal** – Process CO_2emissions from the use of fossil fuel-derived methanol for biological nitrogen removal *7)* **Emissions from Cluster Package Systems** – Process emissions from operation of cluster package systems *8)* **Emissions from Effluent Discharge** – Fugitive N_2O emissions from effluent discharge It may be possible to differentiate between emissions from wastewater from community vs. waste from other communities.	**Process emissions associated with generation of wastewater by the Community.** The share of process emissions at regional wastewater treatment facilities that is associated with wastewater generated by the community.
Use of septic systems in the community Fugitive methane emissions from septic systems used in the community.	**Use of septic systems by the community** Fugitive methane emissions from septic systems used in the community.

Table 6. Expanded Definitions Continued

GHG Emissions Sources	Activities Resulting in GHG Emissions
Agricultural Livestock	
Domesticated animal production in the community Emissions associated with domesticated animal production occurring within the community boundary. Methods are included for estimating animal population and methane emissions associated with enteric fermentation (e.g., digestion in a cow's stomach).	
Manure decomposition and treatment in the community Emissions associated with decomposition and treatment of manure within the community boundary. Methods are included for estimating methane and N_2O emissions from manure management.	
Upstream Impacts of Community-Wide Activities	
GHG Emissions Sources	**Activities Resulting in GHG Emissions**
	Upstream impacts of fuels used in stationary applications by the community Upstream life cycle (cradle-to-pump) emissions associated with production of stationary fuels used within the jurisdictional boundary of the community.
	Upstream and transmission and distribution (T&D) impacts of purchased electricity used by the community Upstream life cycle emissions associated with production of electricity used within the jurisdictional boundary of the community. Upstream impacts of the use of purchased electricity may include consideration of associated transmission and distribution losses.
	Upstream impacts of fuels used for transportation in trips associated with the community Upstream life cycle (cradle-to-pump) emissions associated with production of transportation fuels used in trips associated with the community, including trans-boundary trips. Includes upstream emissions associated with electricity production for electricity used by electric vehicles, which may be partially or fully included in Upstream Impacts of Purchased Electricity. It may be desirable to categorize data into subsets such as: on-road, off-road, rail, air, marine, transit, and electric vehicles.
	Upstream impacts of fuels used by water and wastewater facilities for water used and wastewater generated within the community boundary Upstream life cycle emissions associated with production of the fuels and electricity used in delivery and treatment of water and wastewater used within the jurisdictional boundary of the community, regardless of the location of the water and wastewater facilities.
	Upstream impacts of select materials (concrete, food, paper, carpets, etc.) used by the whole community Upstream life cycle emissions associated with material goods and services used by the whole community (e.g., production of food, fertilizers and concrete used in the community). Note: Additional community-wide flows of goods & services will create significant double counting issues.

Table 7. Expanded Definitions of Independent Consumption-Based GHG Accounting

GHG Emissions Sources	Activities Resulting in GHG Emissions
	Household consumption Gas & electricity, transportation, and the purchase of all other food, goods and services by all households in the community.
	Government consumption Gas & electricity, transportation, and the purchase of all other food, goods and services by all governments in the community.[vii]
	Life cycle emissions of community businesses Gas & electricity, transportation, and the purchase of all other food, goods and services by all businesses in the community.

[vii] Not limited to municipal or county government (for details see Appendix I: Consumption-Based Emission Activities & Sources).

4. Step Three: Complete the Community GHG Report

This chapter provides guidance to help local governments develop and customize GHG inventory reports. Protocol-compliant inventory reporting requirements are explained and guidance is provided to help local governments customize their reporting to convey the stories they wish to feature about GHG emissions (and removals) associated with their communities. Guidance is also provided on organizing data, avoiding double counting, and presenting GHG emissions data in context to add value for the reader.

Inventory reporting has evolved since the Protocol was first published, with the introduction of online reporting platforms such as carbon*n* and CDP (formerly Carbon Disclosure Project), and initiatives such as the Global Covenant of Mayors that require reporting in order to show aggregate results of local action. These platforms and initiatives have their own specific requirements about what is reported, and in what format as part of a formal disclosure process. As reporting requirements around such initiatives are subject to change, they are not covered in detail here.

In the current context, inventories may be reported in multiple ways, for different audiences and purposes. The information and reporting format most effective for communicating with local elected officials, other stakeholders or the public is likely different than the information needs and data consistency requirements needed for campaigns that operate at national and international scales. Communities and other practitioners should use the results of pre-inventory scoping exercises to determine what kinds of narrative reports and other publications will be needed to support their self-defined goals while being mindful of the requirements of initiatives they have joined or plan to do so in the future.

4.1 Introduction to Reporting

After selecting GHG emission sources and activities to include, gathering data, and quantifying emissions associated with those sources and activities, the third step is to complete the community GHG inventory report.

At minimum, this report will contain data tables on the sources and activities included in the GHG inventory. It is best practice, however, to customize a narrative report based on your reporting goals. By presenting data in the context of the reporting frameworks established in this Protocol, local governments can convey important stories about GHG emissions associated with the community.

This Protocol establishes several requirements for Protocol-compliant community GHG inventory reports. These requirements are described in section 4.2 below, followed by additional guidance to help local governments customize their reporting and avoid potential pitfalls such as double counting.

4.2 Required and Optional Reporting Elements

US Community Protocol-compliant community GHG inventory reports must meet several requirements. The claim of US Community Protocol Compliance is one that will be in many cases, self-declared as a standard of intent of the inventory to support local decision making and report community performance in a way that upholds the Protocol Accounting Principles, see Section 1.4. Verification of an inventory by a qualified third party should assess whether an inventory is in keeping with those principles and that the data, methods, and emissions factors used in the calculations are transparent and documented. The following provides an overview of what is expected to be publically available in some combination of narrative report, appendices, and or formal disclosure to a registry in order to support the claim of compliance.

Requirements for US Community Protocol-Compliant GHG Inventory Reports

- Complete an GHG Report Summary Table that illustrates emissions (and removals) included and excluded from the inventory and presents emissions in CO_2e (Appendix B is provided as an example)
- Include quantified estimates of emissions associated with the five Basic Emissions Generating Activities (see section 2.2)
- Include data for each emissions source or activity on a line item basis, and for each include:
  - Activity data
  - Emission factors used (w/ source)
  - Emissions in CO_2e
  - Accounting method used
- Include community context data (at minimum, total population and households in the inventory year).

It is best practice, but optional, to include additional information (e.g., notes on data sources, confidence in data accuracy, additional context data), and to present data using the recommended reporting frameworks. See sections 4.3 and 4.4 for guidance on these reporting recommendations.

4.2.1 Create a GHG Report Summary Table

It is a requirement for Protocol-compliant inventories to provide a table showing emissions (and removals) included and excluded from the inventory and presenting GHGs in CO2e. The table must utilize Protocol "notation keys" to indicate why a source or activity was included or excluded; these notation keys are described in Appendix B.

4.2.2 Include Required Reporting Data

As noted in the box above, for each source and activity included in the GHG inventory report (including, but not limited to the five required Basic Emissions Generating Activities), the following data must be reported on a line-item basis.

This data may be presented in a table or appendix and need not be the focus of the narrative report:

- GHG emissions / removals (in metric tons of CO_2e)
- Activity data (e.g., kWh used, tons to landfill)
- Emission / removal factors used (with units; cite source)
- Emissions in CO_2e
- Accounting method used

Local governments generally collect all of this information in the course of calculating GHG emissions and removals. This requirement is intended to facilitate more accurate and efficient future reporting, allow comparison with other communities, and to help readers to understand the reporting conclusions. GHG accounting methods used should be summarized using the Protocol number and name of the accounting method, or a brief description if a unique accounting method has been developed that better meets the Protocol accounting principles.

Finally, as noted in the box above, Protocol-compliant inventory report must include the following context data:

- Total community population
- Number of residential households

This information will allow interpreting GHG reporting in context. For example, it is useful to view residential energy use and associated GHG emissions on both an absolute and on a per household basis. Including additional local context data is encouraged (see section 4.4.2); the above two items are required based on data availability and relevance to all communities.

4.3 Customizing the Report Using Reporting Frameworks

In the first step of the process (scoping), the local government considers its reporting goals and the optional reporting frameworks below that are best suited to achieving those goals in order to identify what emissions to account for. The narrative report can be structured around these reporting frameworks.

Strongly Encouraged (in order of recommended priority):

- Local Government Significant Influence
- Community-Wide Activities
- Household Consumption

Also Encouraged:

- In-Boundary Sources
- Government Consumption
- Full Consumption-based Inventory
- Life Cycle Emissions of Community Businesses
- Individual Industry Sectors

- Create Your Own Story

Each of these reporting frameworks can be used to convey a particular story about GHG emissions associated with the community, generally involving different combinations of the emission sources and activities listed in Table 2. Emissions figures collected under a reporting framework can be presented with a narrative that describes the meaning and significance of the framework story. The narrative may describe why the reporting framework was chosen, and how the local government will use the particular GHG report to manage community-wide emissions. For example, the local government may use the Local Government Significant Influence report to set emission reduction goals and identify emission reduction actions, while using the Household Consumption report to educate community members about their carbon footprint. There are many possibilities for constructing a narrative that communicates the meaning of these frameworks in the inventory report.

It is important to note that community GHG emissions can be presented through multiple reporting frameworks in a single inventory report, and that some sources and activities will be reported under more than one framework. Each framework will provide a different perspective on emissions generated in and by your community, and together they will produce a more complete picture. This perspective can help to educate and motivate the community to identify and advance GHG reduction opportunities and enable more appropriate comparisons over time and with other communities.

4.4 Optional Reporting Recommendations

4.4.1 Recommended Report Elements

Local governments should consider including the following elements in their community GHG inventory reports.

- Description of the purpose and scope of the inventory report
- Summary of GHG inventory data, including changes over time
- Presentation of GHG inventory data by sector (e.g., residential, commercial, and industrial energy use)
- Discussion of data observations
- Detailed GHG inventory data, with description of methods (often in an appendix)
- Additional context data (if applicable)
- Notes (e.g., assumptions, data sources, quantification methods used, comments on why emissions have not been reported)

4.4.2 Optional Context Data

Local governments are encouraged to include other available context data in addition to that required in section 4.2. Examples of potentially useful context data include:

- Economic activity data
- Population density
- Land area

- Number of jobs by industry
- Tourism revenue
- Residential energy use per household
- Commercial/industrial energy use per unit of economic output or full-time employee
- Average passenger VMT per resident or service population
- Percent of solid waste sent to recycling vs. composting vs. landfill or incineration
- Quantity of solid waste disposed (by landfill or incineration) per capita

4.4.3 Information on GHG Reduction Efforts

Local governments may wish to integrate their reporting of community GHG inventory data with other information to help communicate the results of implemented GHG emissions reduction actions.

Local governments may also wish to include information on GHG emission benefits associated with actions that have been taken to reduce emissions; carbon offset projects, including sequestration-related projects; or purchased carbon credits. This Protocol requires community GHG inventories to feature gross GHG emissions data, and optionally to report net emissions and/or sequestration from land use. Local governments have the option to also include information on GHG benefits associated with specific activities in the process of their reporting, so long as this information is presented separately from gross emissions data calculated using the methods provided by this Protocol (net numbers alone are not permissible). It is most appropriate to include information on these additional activities in the context of climate action plans and implementation progress reports.

4.5 Aggregating Emissions and Comparing Across Jurisdictions

Protocol-compliant GHG inventories must, at minimum, disclose data on each included GHG emission source and activity as individual reporting line items. Local governments may also optionally sum GHG emissions to report a total for each reporting framework. By totaling the same set of emission sources or activities for separate analysis years, local governments can illustrate changes in this set of emissions over time.

Local governments may also choose to report subtotals of GHG emissions associated with subsets of community activity to provide new perspective for specific audiences and purposes. For example, they may wish to highlight life cycle GHG emissions associated with seasonal tourism to inform innovative GHG mitigation strategies that address the supply chain of the hospitality industry. There are many potential purposes and ways that emissions can be summed and reported to meet local goals. However, aggregating emissions figures should be undertaken deliberately, taking account of some of the potential pitfalls described below.

4.5.1 Double Counting

Reporting on GHG emissions associated with communities inherently involves potential overlap with reporting that may also be occurring at smaller scales (e.g., by individual organizations within the community reporting to carbon trading registries) or larger scales (e.g., by

governments aggregating state or national emissions for reporting pursuant to national or international agreements). Community GHG inventories are not intended to be exclusive of reporting at other scales.

Similarly, community GHG inventory reports can also include emissions data that might overlap with that reported by other communities. For example, the same quantity of emissions may be reported by one community as having been released from a source of emissions (i.e., the power plant) located within its boundary, and by another community as emissions associated with its use of electricity (supplied by the power plant in the first community). For this reason, emissions associated with **sources** in one community should generally not be added to emissions associated with **activities** occurring in another community.

This general rule of thumb also applies to emission sources and activities associated with the same community. Emissions associated with either sources or activities alone can generally be summed, but emissions from sources and activities should generally not be added together due to potential for double counting within a total. This Protocol differentiates sources and activities, in part, to help communities avoid double counting. Each of the examples below illustrates a situation in which the emissions from a source and the emissions associated with an activity should not be added together.

> ***Example 1 – Electricity Use:*** A community uses electricity produced at a power plant located within the community boundary. The local government believes it can influence both the amount and types of fuel used to produce electricity in the power plant (i.e., the source) and the amount of energy used in community buildings (i.e., the activity), and chooses to include emissions from both perspectives in its community inventory report. Potential exists for double counting if a local government were to add GHG emissions associated with electricity used in the community and the actual GHG emissions produced at the power plant.
>
> ***Example 2 – Solid Waste Disposal:*** A community sends its solid waste to a landfill located within the community boundary. This landfill also accepts waste from other communities. The local government chooses to report on emissions associated with both the rate at which methane produced by the landfill is able to escape to the atmosphere (i.e., the source) and the amount of waste sent to landfill by its community members (i.e., the activity). Because estimates from each perspective are partially a function of the same variables (e.g., the amount and type of material entering the landfill and the methane recovery rate associated with any installed methane capture technology), potential exists for double counting if these emissions estimated from these two perspectives were to be added together.

Double counting can also exist among emissions numbers associated with separate community activities. For example, energy use associated with water and wastewater infrastructure may also be partially or fully included in the use of purchased electricity and stationary combustion equipment. In this situation, adding emissions associated with community energy use and water use can result in partial double counting. Because community energy use data is often provided only in aggregate terms, and energy use data associated with water infrastructure in the community is often unknown, it can be difficult to avoid partial double counting when emissions from these activities are aggregated. In cases where double-counting is unavoidable, the user should take care to describe the extent of double-counting or to disclose the potential for double-counting when the quantity cannot be estimated.

Finally, emissions totals developed under one of the reporting frameworks should not be summed with total emissions calculated under another of the reporting frameworks. Several of the reporting frameworks include overlapping emission sources and activities, creating potential for double counting were these to be summed. The risk of double counting increases as more emission sources and activities are included.

For all of the reasons described above, great care should be taken in any aggregation of emissions. A full representation of how a community contributes to GHG emissions will benefit from inclusion of more than one "total" figure and reporting framework. It is exceptionally difficult to add all emissions together into a single comprehensive total without some double counting.

4.5.2 Transparency in Communicating Aggregate Emissions

When reporting any form of total community GHG emissions, local governments should carefully qualify any "totals" to help casual readers understand that the "total" does not include all GHG emission sources and activities that could be associated with the community. When writing an inventory report, local governments are encouraged to use bar charts and other visual tools rather than pie charts for graphically representing emissions, where appropriate. The use of pie charts (or other graphs where emissions are shown as percentages of a total) should be qualified so as to not imply that the emissions shown are comprehensive.

4.5.3 Comparison with Other Communities

It is anticipated that occasional efforts will be made by various parties to compare GHG emissions across communities. Any efforts to compare community GHG emissions should:

- Include context information (e.g., per capita and other relevant figures needed to normalize results);
- Give consideration to how those communities individually track and present their community GHG emissions reporting;
- Avoid inappropriately combining or misrepresenting GHG emission generating activities and sources (e.g., reporting total emissions for multiple communities where the set of emission sources summed to create those totals varies significantly); and,
- Provide complete transparency regarding GHG emission generating activities and sources included and excluded from the comparison to enable appropriate interpretation.

4.6 Integration with Local Government Operations Reporting

Local governments are encouraged to separately report on GHG emissions associated with their own operations as guided by the Local Government Operations Protocol (LGO Protocol). First released in 2008 and updated in 2010, the LGO Protocol was developed through a collaboration of ICLEI USA, the California Air Resources Board, the California Climate Action Registry, and The Climate Registry. The LGO Protocol is the U.S. national standard guide for quantifying and reporting GHG emissions associated with local government operations.

Since a local government is inherently part of the community it represents, care should be taken when reporting on emissions from local government operations. Many of the emission generating sources and activities in a local government inventory will be included in community-

wide emissions, such as energy and electricity use. In this sense, the separate government operations inventory is a "drill-down" of the community inventory.

More information on the LGO Protocol is available on the ICLEI USA website at www.icleiusa.org/tools/ghg-protocol/local-government-operations-protocol.

4.7 Reporting Requirements of the Global Protocol for Community-Scale GHG Emissions

Local governments may wish to fulfill reporting requirements of the Global Protocol for Community-Scale GHG Emissions (GPC) simultaneously with those of this Protocol. These users should refer to the GPC as they establish the scope of their inventory to ensure GPC reporting requirements will be met; at the time of this writing, the GPC requires inclusion of sources and activities that are not required by this protocol. The notation keys from the Community GHG Sources and Activities Tracking Tables provided in Appendix B correspond directly with notation keys from the GPC. The table below lists the emissions sources required by the GPC.

***For Reference Purposes Only*:**

List of Required Sources in Pilot Version 1 of the Global Protocol for Community-Scale GHG Emissions (GPC)

Stationary Sources
- Direct Emissions (in-boundary fuel combustion)
- Energy Indirect Emissions (associated with in-boundary energy use)
- Fugitive Emissions (in-boundary)

Mobile Sources

On-Road Transportation
- Direct Emissions (in-boundary fuel combustion)
- Energy Indirect Emissions (associated with in-boundary energy use)

Railways
- Direct Emissions (proportional fuel combustion)
- Energy Indirect Emissions (proportional energy use)

Water-Borne Navigation
- Direct Emissions (proportional fuel combustion)
- Energy Indirect Emissions (proportional energy use)

Aviation
- Direct Emissions (proportional fuel combustion)
- Energy Indirect Emissions (proportional energy use)

Off-Road
- Direct Emissions (in-boundary fuel combustion)

Waste

Solid Waste Disposal, Biological Treatment, and Incineration
- Direct Emissions from Landfills, Incinerators, and Other Waste Facilities Located Within the Community Boundary
- Indirect Emissions from Community Wastes Deposited in Landfills, Incinerators, and Other Waste Facilities Located Outside the Community Boundary

Wastewater Treatment and discharge
- Direct Emissions from WWT and discharge in the Community Boundary
- Indirect Emissions from WWT and discharge Outside the Community Boundary

Industrial Processes and Product Use (IPPU)
- Direct Emissions from Industrial Processes (in-boundary production)
- Direct Emissions from Product Use (in-boundary product use)

Appendix A. Glossary, Abbreviations, and Acronyms

Glossary of Terms

Activity	Refers to a community use activity (or activities), which is defined as the use of energy, materials, and/or services by members of the community that result in the creation of GHG emissions either directly (e.g., use of household furnaces and vehicles with internal combustion engines) or indirectly (e.g., use of electricity created through combustion of fossil fuels at a power plant, consumption of goods and services whose production, transport and/or disposal resulted in creation of GHG emissions directly or indirectly).
Activity data	Data on the magnitude of a human activity resulting in emissions taking place during a given period of time. Data on energy use, fuel used, miles traveled, input material flow, and product output are all examples of activity data that might be used to compute GHG emissions.
Additionality	The extent to which an emissions mitigation measure, strategy, or action adds to existing reduction efforts rather than duplicating, replacing, or otherwise bringing about a reduction that would have occurred anyway and therefore results in a greater aggregate reduction.
Annual	A frequency of once a year; unless otherwise noted, annual events such as reporting requirements will be based on the calendar year.
Anthropogenic emissions	GHG emissions that are a direct result of human activities or are the result of natural processes that have been affected by human activities.
Analysis year	The single year timeframe for which GHG emissions are being quantified and reported. Typically, the analysis year refers to when the emissions occur, but in some cases it refers to when the activity occurs (e.g., future emissions resulting from disposal of waste in the analysis year).
Base year emissions	GHG emissions in chosen year against which a community's emissions are compared over time.
Biochemical oxygen demand (BOD_5)	The oxygen used in meeting the metabolic needs of aerobic microorganisms in water rich in organic matter (as water polluted with sewage).
Biofuel	Fuel made from biomass, including wood and wood waste, sulphite lyes (black liquor), vegetal waste (straw, hay, grass, leaves, roots, bark, crops), animal materials/waste (fish and food meal, manure, sewage sludge, fat, oil and tallow), turpentine, charcoal, landfill gas, sludge gas, and other biogas, bioethanol, biomethanol, bioETBE, bioMTBE, biodiesel, biodimethylether, fischer tropsch, bio oil, and all other liquid biofuels which are added to, blended with, or used straight as transportation diesel fuel.
Biogenic emissions from combustion	CO_2 emissions produced from combusting a variety of biofuels and biomass, such as biodiesel, ethanol, wood, wood waste and landfill gas.
Biomass	Non-fossilized organic material originating from plants, animals, and micro-organisms, including products, byproducts, residues and waste from agriculture, forestry and related industries as well as the non-fossilized and biodegradable organic fractions of industrial and municipal wastes, including gases and liquids

	recovered from the decomposition of non-fossilized and biodegradable organic material.
Boundaries	GHG emission accounting and reporting boundaries for a community have two dimensions, in-boundary and trans-boundary. In-boundary emissions are GHG emissions released within the jurisdictional boundary of a community. Examples include GHG emissions from natural gas combustion in household furnaces and gasoline combustion in motor vehicles driven on roads within the community's jurisdictional boundary. Trans-boundary emissions are GHG emissions occurring outside the jurisdictional boundary of a community as a result of activities occurring within the community boundary (see "Trans-boundary Emissions" for more details). Note: community boundaries are distinct from boundaries as defined in the Local Government Operations Protocol in which a boundary can have several dimensions, i.e., organizational, operational, and geographic. Those latter boundaries determine which emissions are accounted for and reported by the local governmental entity.
British thermal unit (Btu)	The quantity of heat required to raise the temperature of one pound of water by one degree Fahrenheit at about 39.2 degrees Fahrenheit.
Butane	A normally gaseous straight-chain or branch chain hydrocarbon extracted from natural gas or refinery fuel gas streams and is represented by the chemical formula C_4H_{10}. Butane includes normal butane and refinery-grade butane.
Carbon dioxide (CO_2)	The most common of the six primary GHGs, consisting of a single carbon atom and two oxygen atoms, and providing the reference point for the GWP of other gases. (Thus, the GWP of $CO_2$is equal to 1.)
Carbon footprint	The total volume of GHG emissions caused by a community, organization, event, product, or person.
Carbon offset	A credit or financial instrument that an individual, organization, or other entity may purchase to negate carbon emissions. Revenue from carbon offsets are typically used to fund climate change mitigation or adaptation efforts.
Carbon sink	A biological system or other natural environment, such as a forest or a body of water, that absords more carbon dioxide from the atmosphere than it releases.
Carbon stock	The carbon embodied in a biological system, such as oceans, trees and the atmosphere. A carbon stock that is taking up carbon is called a "sink" and one that is releasing carbon is called a "source".
CO_2 equivalent (CO_2e)	The universal unit for comparing emissions of different GHGs expressed in terms of the GWP of one unit of carbon dioxide.
Combined heat and power (CHP)	See co-generation.
Co-generation	An energy conversion process in which more than one useful product (e.g., electricity and heat or steam) is generated from the same energy input stream. Also referred to as combined heat and power (CHP).
Community	Community traditionally refers to residents, businesses, industries, and government co-located within a jurisdictionally defined area.
Community use activities	Use of energy, materials, and services by all members of the community that result in the creation of GHG emissions either directly (e.g., use of household furnaces

	and vehicles with internal combustion engines) or indirectly (e.g., use of electricity created through combustion of fossil fuels at a power plant, consumption of goods and services whose production, transport and/or disposal resulted in creation of GHG emissions directly or indirectly). Also see "Use" defined below.
Continuous emissions monitoring system (CEMS)	The total equipment required to obtain a continuous measurement of a gas concentration or emission rate from combustion or industrial processes.
Consumption	A subset of "Use". See definition of "Use" for details.
Consumption activities	These focus on a sub-set of community-use activities related to the use of energy, materials, goods and services by a sub-set of the community: resident households, governments and only the capital (including construction) and inventory formation activities of local businesses. The use of energy, materials, goods and services by local business operations that serve visitors or that export goods and services to elsewhere are excluded in a consumption-view of a community.
De minimis	Per the California Climate Action Registry's program-specific requirements, emissions reported for a source or sources that are estimated using alternate methodologies that do not meet CCAR's third-party verification requirements. De minimis emissions can be from one or more sources, for one or more gases which, when summed, equal less than 5% of an organization's total emissions.
Direct monitoring	Direct monitoring of exhaust stream contents in the form of continuous emissions monitoring (CEM) or periodic sampling.
Double counting	Two or more reporting entities taking ownership of the same emissions or reductions, or the same reporting entity counting the same emissions twice.
Emission factor	A unique value for determining an amount of a GHG emitted on a per unit activity basis (for example, metric tons of CO_2 emitted per million Btus of coal combusted, or metric tons of CO_2 emitted per kWh of electricity consumed).
Entity	Any business, corporation, institution, organization, government agency, etc., recognized under U.S. law and comprised of all the facilities and emission sources delimited by the organizational boundary developed by the entity, taken in their entirety.
Ethane	A normally gaseous straight-chained hydrocarbon that boils at a temperature of -127.48 degrees Fahrenheit with a chemical formula of C_2H_6.
Facility	Any property, plant, building, structure, stationary source, stationary equipment or grouping of stationary equipment or stationary sources located on one or more contiguous or adjacent properties, in actual physical contact or separated solely by a public roadway or other public right-of way, and under common operational or financial control, that emits or may emit any greenhouse gas.
Fossil fuel	A fuel, such as coal, oil, and natural gas, produced by the decomposition of ancient (fossilized) plants and animals.
Fugitive emissions	Emissions that are not physically controlled but result from the intentional or unintentional release of GHGs. They commonly arise from the production, processing, transmission, storage and use of fuels or other substances, often through joints, seals, packing, gaskets, etc. Examples include HFCs from refrigeration leaks, SF_6 from electrical power distributors, and CH_4 from solid waste landfills.

Global warming potential (GWP)	The ratio of radiative forcing (degree of warming to the atmosphere) that would result from the emission of one mass-based unit of a given GHG compared to one equivalent unit of carbon dioxide (CO_2) over a given period of time.
Greenhouse gas emissions (GHGs)	Greenhouse gas emissions are gases that trap heat in the atmosphere. Some greenhouse gases such as carbon dioxide occur naturally and are emitted into the atmosphere through natural processes and human activities. Other greenhouse gases are created and emitted solely through human activities. The principal greenhouse gases that enter the atmosphere because of human activities are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and fluorinated gases (hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride).
GHG emission sources and associated activities	GHG emission sources are any physical process or activity that releases GHG emissions into the atmosphere. Examples of emission sources include: vehicle exhaust from combustion of gasoline, furnace exhaust from the combustion of natural gas, power plant exhaust from the combustion of coal for the production of electricity, fugitive emissions from leaking refrigerants, and methane emissions from a landfill. Activities associated with GHG emission sources are human activities that result in the production of GHG emissions. An example is electricity use, which requires the generation of electricity at a power plant that may produce a quantity of GHG emissions in the process of generating the electricity.
Greenhouse gas credit	GHG offsets can be converted into GHG credits when used to meet an externally imposed target. A GHG credit is a convertible and transferable instrument usually bestowed by a GHG program.
Greenhouse gas offset	Offsets are discrete GHG reductions used to compensate for (i.e., offset) GHG emissions elsewhere, for example to meet a voluntary or mandatory GHG target or cap. Offsets are calculated relative to a baseline that represents a hypothetical scenario for what emissions would have been in the absence of the mitigation project that generates the offsets.
Greenhouse gas sink	Any physical unit or process that stores GHGs; usually refers to forests and underground/deep sea reservoirs of CO_2.
Greenhouse gas emission sources	Any physical process or activity that releases GHG emissions into the atmosphere (e.g., vehicle exhaust from combustion of gasoline, furnace exhaust from the combustion of natural gas, power plant exhaust from combustion of coal for the production of electricity).
Green power	A generic term for renewable energy sources and specific clean energy technologies that emit fewer GHG emissions relative to other sources of energy that supply the electric grid. Includes solar photovoltaic panels, solar thermal energy, geothermal energy, landfill gas, low-impact hydropower, and wind turbines.
Heating value	The amount of energy released when a fuel is burned completely. Care must be taken not to confuse higher heating values (HHVs), used in the US and Canada, and lower heating values, used in all other countries.
Higher heating value (HHV)	The high or gross heat content of the fuel with the heat of vaporization included. The water vapor is assumed to be in a liquid state.
Hydrofluorocarbons (HFCs)	One of the six primary GHGs, a group of manmade chemicals with various commercial uses (e.g., refrigerants) composed of one or two carbon atoms and varying numbers of hydrogen and fluorine atoms. Most HFCs are highly potent GHGs with 100-year GWPs in the thousands.

In-boundary emissions	GHG emissions released within the jurisdictional boundary of a community. Examples include GHG emissions from natural gas combustion in household furnaces and gasoline combustion in motor vehicles driven on roads within the community's jurisdictional boundary.
Inorganic	Being or composed of matter other than plant or animal.
Intergovernmental Panel on Climate Change (IPCC)	International body of climate change scientists. The role of the IPCC is to assess the scientific, technical and socio-economic information relevant to the understanding of the risk of human-induced climate change (www.ipcc.ch).
Inventory	A comprehensive, quantified list of a community's or organization's GHG emissions and sources.
Inventory boundary	An imaginary line that encompasses the GHG emissions included in the inventory. It results from the chosen organizational and operational boundaries.
Joule	A measure of energy, representing the energy needed to push with a force of one Newton for one meter.
Kerosene	A light distillate fuel that includes No. 1-K and No. 2-K as well as other grades of range or stove oil that has properties similar to those of No. 1 fuel oil.
Kilowatt hour (KWh)	The electrical energy unit of measure equal to one thousand watts of power supplied to, or taken from, an electric circuit steadily for one hour. (A Watt is the unit of electrical power equal to one ampere under a pressure of one volt, or 1/746 horsepower.)
Kyoto Protocol	A protocol to the United Nations Framework Convention on Climate Change (UNFCCC). Ratified in 2005, it requires countries listed in its Annex B (developed nations) to meet reduction targets of GHG emissions relative to their 1990 levels during the period of 2008–12.
Life cycle analysis	Assessment of the sum of a product's effects (e.g. GHG emissions) at each step in its life cycle, including resource extraction, production, use and waste disposal.
Life cycle emissions	GHG emission sources associated with all stages of the life cycle of materials, energy, and services. These could be materials, energy and services *used* in the community, *consumed* by the community, or *produced* in the community, depending on what kind of activity is being evaluated.[23] Life cycle emissions include the "upstream" supply chain (e.g., resource extraction, production, transport), use, and end-of-life management (including transportation and recycling). For example, the life cycle emissions of vehicle fuels include both combustion emissions (tailpipe emissions), as well as pre-combustion, or "well-to-pump" emissions. These pre-combustion emissions are the upstream emissions associated with extracting and growing fuel feedstocks (petroleum, corn, etc.), refining those feedstocks into fuels, and transporting the fuels to the point of sale. Two subsets of life cycle emissions are "embodied" emissions and "end-of-life" emissions.

[23] For example: the emissions associated with all (residential, business, government) electricity purchases in a community are related to electricity *use in the community*. Electricity "consumed" in the community is different from electricity "used" in the community; "consumption" is limited to final demand (purchases by households, and possibly also governments and investment expenditures by businesses [see definition of 'Use' and Appendix I for additional details]). In contrast, the emissions from an in-community landfill are related to provision of a *service produced in the community* (the service being landfill disposal). All of these activities have life cycle emissions that extend beyond the direct emissions at the electricity generating facility or landfill.

	• Embodied life cycle emissions represent emissions across the life cycle prior to the activity being evaluated, but excluding emissions associated with use. For example, the emissions associated with the supply chain of automobile manufacturing are called "embodied life cycle emissions" when a car is sold into a community. If a used car is sold into a community, or brought into the community for the purpose of end-of-life management, its embodied emissions do not include emissions associated with prior operation of the car. Embodied life cycle emissions, when they occur outside the community boundary, are trans-boundary emissions; however, embodied life cycle emissions can also occur in-boundary. • End-of-life emissions represent emissions associated with recycling, landfilling, composting, combustion, or other end-of-life management of products and materials. These may be products and materials used in the community, or imported into the community as wastes for the purpose of disposal. Examples include methane emissions from waste produced in the community and placed in a landfill in some other community, as well as methane emissions from waste produced anywhere and placed in a landfill that the community hosts. These end-of-life life cycle emissions, when they occur outside the community boundary, are trans-boundary emissions; however, life cycle emissions can also occur in-boundary. When the life cycle emissions occur in a different year, appropriate allocation methods must be applied to allocate them appropriately.
Liquefied petroleum gas (LPG)	A group of hydrocarbon-based gases derived from crude oil refining or natural gas fractionation. They include propane, propylene, normal butane, butane, butylene, isobutene A-14 and isobutylene. For convenience of transportation, these gases are liquefied through pressurization.
Lower heating value (LHV)	Low or net heat content with the heat of vaporization excluded. The water is assumed to be in the gaseous state.
Methane (CH_4)	One of the six primary GHGs, consisting of a single carbon atom and four hydrogen atoms, possessing a GWP of 21, and produced through the anaerobic decomposition of waste in landfills, animal digestion, decomposition of animal wastes, production and distribution of natural gas and petroleum, coal production, and incomplete fossil fuel combustion.
Metric ton (mt)	Common international measurement for the quantity of GHG emissions, equivalent to about 2,204.6 pounds or 1.1 short tons.
Mobile combustion	Emissions from the combustion of fuels in transportation sources (e.g., cars, trucks, buses, trains, airplanes, and marine vessels) and emissions from off-road equipment such as what is used in construction, agriculture, and forestry. A piece of equipment that cannot move under its own power, but that is transported from site to site (e.g., an emergency generator) is a stationary, not a mobile, combustion source.
Nameplate (generating) capacity	The maximum rated output of a generator under specific conditions designated by the manufacturer, expressed in megawatts (MW) or kilowatts (kW).
Natural gas	A naturally occurring mixture of hydrocarbons (e.g., methane, ethane, or propane) produced in geological formations beneath the earth's surface that maintains a gaseous state at standard atmospheric temperature and pressure under ordinary conditions.
Nitrous oxide (N_2O)	One of the six primary GHGs, consisting of two nitrogen atoms and a single oxygen atom, possessing a GWP of 310, and typically generated as a result of soil

	cultivation practices, particularly the use of commercial and organic fertilizers, fossil fuel combustion, nitric acid production, and biomass burning.
Operational control	Full authority to introduce and implement operating policies at an operation.
Operator	The entity having operational control of a facility or other entity.
Organic	Of, relating to, or derived from living organisms.
Organizational boundaries	The boundaries that determine the operations owned or controlled by the reporting entity, depending on the consolidation approach taken.
Perfluorocarbons (PFCs)	One of the six primary GHGs, A group of man-made chemicals composed of one or two carbon atoms and four to six fluorine atoms, containing no chlorine. Originally introduced as alternatives to ozone depleting substances, PFCs have few commercial uses and are typically emitted as by-products of industrial and manufacturing processes. PFCs have very high GWPs and are very long-lived in the atmosphere.
Process emissions	Emissions from physical or chemical processing rather than from fuel combustion. Examples include emissions from manufacturing cement, aluminum, adipic acid, ammonia, etc.
Propane	A normally straight chain hydrocarbon that boils at -43.67 degrees Fahrenheit and is represented by the chemical formula C_3H_8.
Renewable Energy Certificates/Credits (RECs)	A market tradable commodity that represents proof that one megawatt-hour (MWh) of electricity was generated from a third-party verified renewable energy resource, such as a solar renewable energy certificate (SERC) that is generated from solar energy resource.
Reporting frameworks	Various aproaches or lenses that a local government can use to identify and represent GHG emissions associated with a given community.
Residual fuel oil	A general classification for the heavier oils, known as No. 5 and No. 6 fuel oils, that remain after the distillate fuel oils and lighter hydrocarbons are distilled away in refinery operations.
Scope(s)	Scopes are used in the context of reporting on GHG emissions associated with individual organizational entities (e.g., the operations of a business or local government). In that context, the scopes framework can be used to categorize direct (scope 1) emissions (e.g., smoke stacks or tailpipes that release emissions within an organizational boundary), indirect energy-related (scope 2) emissions (e.g., the use of purchased or acquired electricity, heating, cooling, or steam regardless of where the energy is generated), and other indirect (scope 3) emissions not covered in scope 2 (e.g., upstream and downstream emissions from the extraction and production of purchased materials and fuels). The Community Protocol does not use scopes as a framework for categorizing emissions in community inventories because the organization-related definitions of scopes do not translate to the community scale in a manner that is applicable, clear, and valuable.
Short ton (ton)	Common measurement for a ton in the U.S. and equivalent to 2,000 pounds or about 0.907 metric tons.

Source(s)	Any physical process or activity that releases GHG emissions into the atmosphere (e.g., vehicle exhaust from combustion of gasoline, furnace exhaust from the combustion of natural gas, power plant exhaust from combustion of coal for the production of electricity).
Standard cubic foot (scf)	The amount of gas that would occupy a volume of one cubic foot if free of combined water at standard conditions.
Stationary	Neither portable nor self propelled, and operated at a single facility.
Stationary combustion	Emissions from the combustion of fuels to produce electricity, steam, heat, or power using equipment (boilers, furnaces, etc.) in a fixed location.
Still gas	Gas generated at a petroleum refinery or any gas generated by a refinery process unit, and that is combusted separately or in any combination with any type of gas or used as a chemical feedstock.
Sulfur hexafluoride (SF_6)	One of the six primary GHGs, consisting of a single sulfur atom and six fluoride atoms, possessing a very high GWP of 23,900, and primarily used in electrical transmission and distribution systems.
Therm	A measure of one hundred thousand (10^5) Btu.
Trans-boundary emissions	GHG emissions occurring outside the jurisdictional boundary of a community as a result of activities occurring within the community boundary. Examples include: GHG emissions at out-of-boundary power plants that produce electricity used in-boundary, GHG emissions from vehicle exhaust from the out-of-boundary portions of vehicle trips that start or end within the boundary, and life cycle emissions associated with materials used in the community that are produced elsewhere. Trans-boundary emissions can be considered in the following three categories. • Trans-boundary GHG emissions from individual human activities that cross the city boundary, such as commuter travel that occurs regionally across cities, would be artificially truncated at the city boundary if one were to only account for in-boundary GHG emissions related to commuter trips. • Trans-boundary GHG emissions from the life cycle of key infrastructure products that are used community wide, but cross city boundaries, such as electricity transmitted over the power grid. A full life cycle accounting of GHG emissions from electric power generated outside of a jurisdictional boundary would include – resource extraction (e.g., mining of coal), electricity production (burning coal at the power plant), transport (line losses) and end-use in communities (which has zero direct emissions). Considering only direct, in-boundary GHG emissions from the use of electricity produced outside a community's jurisdictional boundary would erroneously yield zero emissions, simply because all the GHG emissions associated with producing electricity happen to occur outside the boundary. The same can be said for water supply networks, waste management infrastructures, transportation networks, and fuel supply chains that cross-jurisdictional boundaries. • Trans-boundary GHG emissions from the life cycle of other trade-related products and services. It is also possible to measure other, non-infrastructure related GHG emissions from the trade of goods and services across jurisdictional boundaries. For example, if a resident of one city purchases a loaf of bread in another city, the bread was "imported" into its city of use. In a traditional inventory the emissions related to making the bread (baking, not supply chain) would be counted in the city of origin, not the city of use. However, using trans-boundary life cycle accounting

	the emissions from the production of the bread would be included in the inventory of the city where the bread was used. As another example, paper may be imported into a community, either to serve final consumption by households or for use in export activities such as at a financial services firm headquartered in the city. General approaches that multiply the use of materials/services by life cycle GHG emission factors can be used to assess these impacts. More specific approaches may focus on a few large businesses, or focus exclusively on the consumers in the community.
Use	Putting into action or service energy, water, materials, or services. In this Protocol, the term "use" is not the same as "consumption". The term "use" refers to any and all use, by all potential users of energy, water, materials, or services, while "consumption" is a subset of "use", limited to the use of resources - typically purchased - by "consumers". "Consumers", in turn, are usually limited to just households and governments, and not businesses, although a subcategory of business expenses (described in Chapter 3.4.7 Consumption-Based Emissions) are sometimes also included in "consumption". In the language of this Protocol, businesses, governments, and households all "use" electricity, but only governments and households "consume" electricity, since businesses use it to create products and services for consumers. For households and governments, "consumption" and "use" of electricity are the same. Although "use" and "consumption" are often used interchangeably in common speech, this distinction is important when it comes to accounting and reporting of consumption-based emissions. For more details on these distinctions, see Appendix I – Consumption-based Emission Activities and Sources.
United Nations Framework Convention on Climate Change (UNFCCC)	Signed in 1992 at the Rio Earth Summit, the UNFCCC is a milestone Convention on Climate Change treaty that provides an overall framework for international efforts to mitigate climate change. The Kyoto Protocol is a protocol to the UNFCCC.
Verification	An independent assessment of the reliability (considering completeness and accuracy) of a GHG inventory.

Abbreviations and Acronyms

AWWA	American Water Works Association
Btu	British thermal unit(s)
ARB	California Air Resources Board
BLS	U.S. Bureau of Labor Statistics
CARROT	Climate Action Registry Reporting Online Tool
CCAR	California Climate Action Registry
CEMS	Continuous Emissions Monitoring System
CFC	chlorofluorocarbon
CH_4	methane
CHP	combined heat and power
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
COP	coefficient of performance
DOE	United States Department of Energy
EF	emissions factor
EIA	United States Energy Information Administration
EIOLCA	economic input-output life cycle analysis
EPA	United States Environmental Protection Agency
FOD	first-order decay
g	gram(s)
GHG	greenhouse gas
GPC	Global Protocol for Community-Scale Greenhouse Gas Emissions
GREET	U.S. DOE's Greenhouse Gases, Regulated Emissions and Energy Use in Transportation model
GRP	General Reporting Protocol
GWP	Global Warming Potential
HCFC	hydrochlorofluorocarbon
HFC	hydrofluorocarbon
HHV	higher heating value
HSE	health, safety, and environment
HV/AC	heating, ventilating, and air conditioning
IPCC	Intergovernmental Panel on Climate Change
ISO	International Organization for Standardization
J	joule
kg	kilogram(s)
kWh	kilowatt-hour(s)

lb(s)	pound(s)
LCA	life cycle assessment/life cycle analysis
LFG	landfill gas
LHV	lower heating value
LPG	liquefied petroleum gas
MMBtu	one million British thermal units
mpg	miles per gallon
MRR	U.S. EPA Mandatory Reporting Rule
MSW	municipal solid waste
mt	metric ton(s)
MWh	megawatt-hour(s)
NDN	nitrification/denitrification
NF_3	nitrogen trifluoride
N_2O	nitrous oxide
NMVOC	non-methane volatile organic compound(s)
NO_x	oxides of nitrogen
NREL	National Renewable Energy Laboratory
ODS	ozone-depleting substances
PFC	perfluorocarbon
REC	renewable energy certificates
SF_6	sulfur hexafluoride
T&D	transmission and distribution
UNFCCC	United Nations Framework Convention on Climate Change
VMT	vehicle miles traveled
VS	Volatile solids excreted by livestock
WARM	U.S. EPA's Waste Reduction Model
WBCSD	World Business Council for Sustainable Development
WRI	World Resources Institute
WTE	Waste-to-energy
WWTP	Wastewater treatment plant

Appendix B

Appendix B. Example Community GHG Inventory Report Summary Table

Protocol-compliant inventories must include a table illustrating included and excluded emissions sources and activities using the notation keys below, along with final emissions figures. The example table below demonstrates one configuration of the required Emissions Report Summary Table.

Instructions:

1) Indicate each emission source or activity that you have included in your community GHG inventory report under the reporting framework in which you have included it. You need only list the reporting frameworks you have used, including any user-defined reporting frameworks not included in this Protocol.
2) For each emission source or activity that you have excluded from your report, insert the appropriate notation keys to indicate why it was excluded. Optionally, a notes field can use be used to provide helpful further explanation why each excluded source or activity has been excluded.

Notation Keys for Excluded Emission Sources and Activities

- **IE – Included Elsewhere**: Emissions for this activity are estimated and presented in another category of the inventory. The category where these emissions are included should be noted in explanation.
- **NE – Not Estimated**: Emissions occur but have not been estimated or reported (e.g., data unavailable, effort required not justifiable).
- **NA – Not Applicable**: The activity occurs but does not cause emissions; explanation should be provided.
- **NO – Not Occurring**: The source or activity does not occur or exist within the community.

Legend for Reporting Frameworks Used

Required Activities:

- Five Basic Emissions Generating Activities

Strongly Encouraged:

- **SI** – Local Government Significant Influence
- **CA** – Community-Wide Activities
- **HC** – Household Consumption

Also Encouraged:

- **IB** – In-Boundary Sources
- **GC** – Government Consumption
- **FC** – Full Consumption-based Inventory
- **LB** – Life Cycle Emissions of Community Businesses
- **IS** – Individual Industry Sectors
- **OS** – Create Your Own Story

Example Community GHG Inventory Report Summary Table [NOTE – THIS REPORTING FORMAT IS AN EXAMPLE FOR USCP DATA STRUCURE. CONSULT FORMAT REQUIREMENTS OF ANY SPECIFIC REGISTRY OR INITAITIVE. Entries are examples only]

Emissions Type		Source or Activity?	FINAL REPORTING - SUMMARY TABLE					
			Included, Required Activities	Included, under reporting frameworks: SI	Included, under reporting frameworks: CA	Excluded (IE, NA, NO, or NE)	Explanatory Notes (optional)	Emissions ($MTCO_2e$)
Built Environment								
Use of fuel in residential and commercial stationary combustion equipment		Source AND Activity	•	•	•			77,664
Industrial stationary combustion sources		Source				NO	No industrial facilities in the community	
Electricity	Power generation in the community	Source		•			Municipally-owned utility	68,795
	Use of electricity by the community	Activity	•					68,198
District Heating/ Cooling	District heating/cooling facilities in the community	Source				NE	This is a very small source here	
	Use of district heating/cooling by the community	Activity				NE	This is not a common activity here	
Industrial process emissions in the community		Source				NO	No industrial facilities in the community	
Refrigerant leakage in the community		Source				NE	No data available	
Transportation and Other Mobile Sources								
On-road Passenger Vehicles	On-road passenger vehicles operating within the community boundary	Source				IE	Obtained data for preferred activity-based method instead	
	On-road passenger vehicle travel associated with community land uses	Activity	•	•	•			255,407
On-road Freight Vehicles	On-road freight and service vehicles operating within the community boundary	Source				NE		
	On-road freight and service vehicle travel associated with community land uses	Activity	•		•			45,234
On-road transit vehicles operating within the community boundary		Source				NE		

Emissions Type		Source or Activity?	FINAL REPORTING - SUMMARY TABLE					
			Included, Required Activities	Included, under reporting frameworks:		Excluded (IE, NA, NO, or NE)	Explanatory Notes (optional)	Emissions ($MTCO_2e$)
				SI	CA			
Transit Rail	Transit rail vehicles operating within the community boundary	Source				NE		
	Use of transit rail travel by the community	Activity				NE	Scoped to include, but no data available	
Inter-city passenger rail vehicles operating within the community boundary		Source				NO		
Freight rail vehicles operating within the community boundary		Source				NE		
Marine	Marine vessels operating within the community boundary	Source				NO		
	Use of ferries by the community	Activity				NO		
Off-road surface vehicles and other mobile equipment operating within the community boundary		Source				NE		
Use of air travel by the community		Activity				NE		
Solid Waste								
Solid Waste	Operation of solid waste disposal facilities in the community	Source		•			We operate the landfill	5,815
	Generation and disposal of solid waste by the community	Activity	•					34,965
Water and Wastewater								
Potable Water - Energy Use	Operation of water delivery facilities in the community	Source				NE		
	Use of energy associated with use of potable water by the community	Activity	•	•	•			4,768
Use of energy associated with generation of wastewater by the community		Activity	•	•	•			2,888

Emissions Type		Source or Activity?	FINAL REPORTING - SUMMARY TABLE: Included, Required Activities	Included, under reporting frameworks: SI	Included, under reporting frameworks: CA	Excluded (IE, NA, NO, or NE)	Explanatory Notes (optional)	Emissions ($MTCO_2e$)
Centralized Wastewater Systems - Process Emissions	Process emissions from operation of wastewater treatment facilities located in the community	Source		•			We operate the wastewater treatment facility	4,008
	Process emissions associated with generation of wastewater by the community	Activity				NE		
Use of septic systems in the community		Source AND activity				NO		
Agriculture								
Domesticated animal production		Source				NE		
Manure decomposition and treatment		Source				NE		
Upstream Impacts of Community-Wide Activities								
Upstream impacts of fuels used in stationary applications by the community		Activity				NE		
Upstream and transmission and distribution (T&D) impacts of purchased electricity used by the community		Activity				NE		
Upstream impacts of fuels used for transportation in trips associated with the community		Activity		•	•			12,652
Upstream impacts of fuels used by water and wastewater facilities for water used and wastewater generated within the community boundary		Activity				IE	Included in rows 32 and 33	
Upstream impacts of select materials (concrete, food, paper, carpets, etc.) used by the whole community. Note: Additional community-wide flows of goods & services will create significant double counting issues.		Activity				NE		

Emissions Type	Source or Activity?	FINAL REPORTING - SUMMARY TABLE					
		Included, Required Activities	Included, under reporting frameworks:		Excluded (IE, NA, NO, or NE)	Explanatory Notes (optional)	Emissions ($MTCO_2e$)
			SI	CA			
Independent Consumption-Based Accounting							
Household Consumption (e.g., gas & electricity, transportation, and the purchase of all other food, goods and services by all households in the community)	Activity				NE	To prioritize, we focused on Significant Influence and Community-wide Activities and not Consumption-Based	
Government Consumption (e.g., gas & electricity, transportation, and the purchase of all other food, goods and services by all governments in the community)	Activity				NE		
Life cycle emissions of community businesses (e.g., gas & electricity, transportation, and the purchase of all other food, goods and services by all businesses in the community)	Activity				NE		
Forests and Trees Outside of Forests							
Emissions and Removals from Forest Land	Source				NE		
Emissions and Removals from Trees Outside of Forests	Source				NE		