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Scope 1 & 2 GHG Inventory Guidance

For U.S. Dairy Cooperatives and Processors

2024
December

BUILT ON GHG PROTOCOL

This U.S. dairy-specific guidance document has been reviewed by the GHG Protocol and is in conformance with the requirements set forth in the Corporate Accounting and Reporting Standard.

Table of Contents

NOTE: This document contains numerous hyperlinked tools and resources. It is, therefore, best viewed and used in PDF rather than print format.

GHG Inventory Guidance

Introduction to this Tool

Increased requests to report greenhouse gas emissions (GHGs) and the establishment of industry-wide GHG reduction targets in the dairy sector have underscored the need for sector-specific guidance on GHG inventory development for the dairy processing industry. This document is a dairy-specific interpretation of recognized GHG accounting standards. It is intended to drive credible and consistent GHG emissions accounting across the dairy processing industry.

The GHG Protocol Corporate Accounting and Reporting Standard serves as the foundation of this document. The Corporate Standard is the most widely accepted and adopted GHG accounting standard.

This guidance also draws on existing accounting programs and protocols that are consistent with the GHG Protocol, including:

- U.S. Environmental Protection Agency Center for Corporate Climate Leadership Greenhouse Gas Inventory Guidance[1]
- The Climate Registry, General Reporting Protocol for the Voluntary Reporting Program, Version 3.0[2]

In addition, this guidance recommends using the U.S. Environmental Protection Agency Simplified GHG Emissions Calculator[3] to estimate and inventory greenhouse gas emissions. This tool is specific to U.S.-based operations and uses the same emission factors as the Intelex software within the Aggregate Reporting Tool. Therefore, processors who do not opt into reporting into the Tool may still voluntarily calculate their own Scope 1 and 2 GHG footprint using the same methodologies as those who do report through the Tool. This ensures consistency and credibility of measurement and reporting to quantify the most accurate estimate of industry-wide processing emissions.

It is important to note that processors who opt into using the Aggregate Reporting Tool (Intelex) will have their Scope 1 and 2 GHG calculations completed for them. Users will still need to establish an inventory management plan, set operational boundaries, collect activity data and enter activity data into the Aggregate Reporting Tool. The Tool will then calculate all GHG emissions and energy use based on the most up-to-date emission factors and best practices from the EPA Center for Corporate Climate Leadership. This ensures consistency across reporting facilities. Processors not using the Aggregate Reporting Tool will need to perform calculations independently following the guidance in this document.

Lastly, this document is intended to be used in conjunction with other Innovation Center for U.S. Dairy resources, including:

- Scope 3 GHG Inventory Guidance for U.S. Dairy Cooperatives and Processors
- Dairy Processor Handbook

How to Use This Document

Each chapter provides an overview of the steps that a company can take to develop a Scope 1 and Scope 2 GHG emissions inventory. Chapters are also devoted to distilling the most important aspects of developing a rigorous, standard-based GHG inventory and providing links to external resources that support the user in further exploring outlined concepts. External resources are hyperlinked into the text and outlined at the end of each chapter.

Purpose and Principles

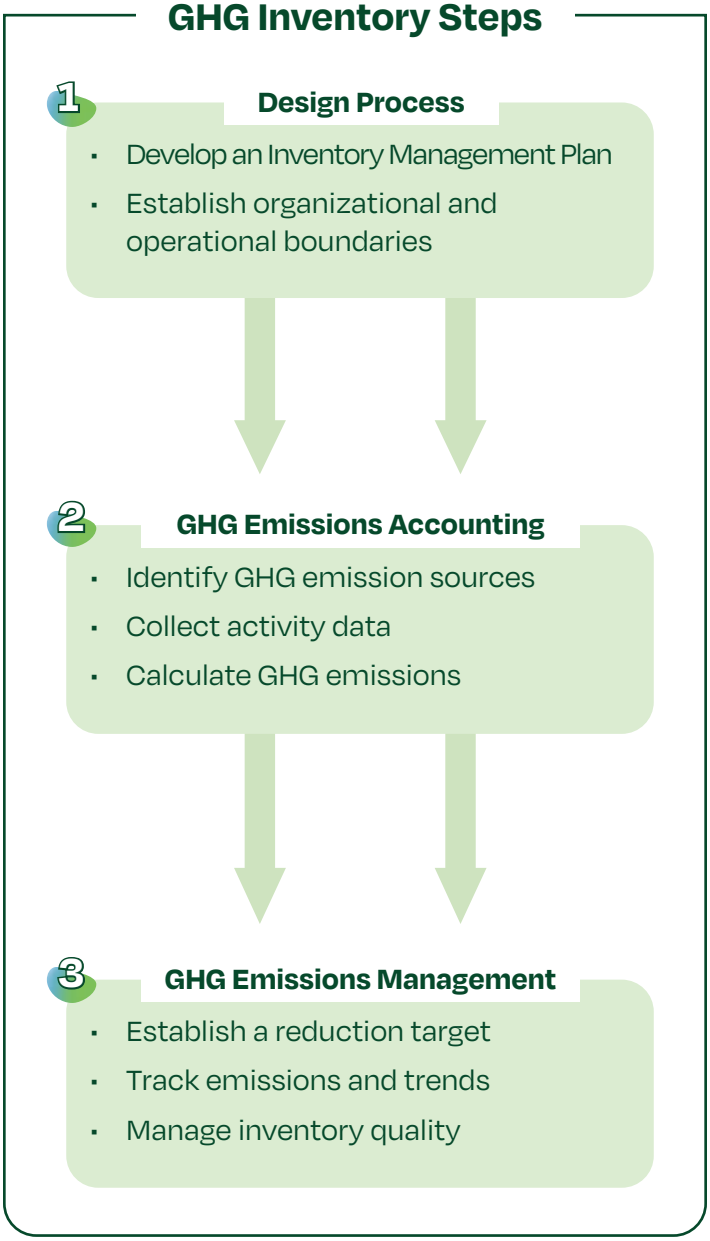
The GHG emissions associated with dairy processing are dependent upon the nature of a company's operations and activities. Given the variability in processing operations and the associated GHG emissions, this document can be used to develop a robust GHG inventory that is unique to each company's inherent characteristics, business goals and reporting requirements. The methodology outlined in this document is based on the GHG Protocol and is, therefore, compatible with most voluntary sustainability reporting frameworks.[4]

Additionally, this document provides a framework for dairy processors to measure and report their GHG emissions in ways that are consistent with the dairy

processor GHG emissions intensity metric defined in the U.S. Dairy Stewardship Commitment as "Total GHG emissions (tonnes, CO_2e Scope 1 and 2) per lb. of production output." More specifically, the guidance seeks to:

1. Assist in preparing a GHG inventory that represents a true and fair account of the company's emissions.
2. Simplify and reduce the costs of compiling a GHG inventory.
3. Support reporting companies in meeting established business goals through the implementation of a credible accounting program.
4. Outline and reference resources that support consistent and transparent GHG accounting methodologies.

NOTE: The Greenhouse Gas Reporting Program is an EPA emissions reporting program for large facilities that emit more than 25,000 metric tons of carbon dioxide equivalent. Companies that report to the GHGRP should follow the EPA's prescribed methodologies when reporting GHG emissions from sources identified on the GHGRP annual report (typically stationary combustion sources). Companies must also include GHG emissions from other sources (refrigerant leaks, transportation emissions, purchased energy, etc.) when calculating their GHG intensity for the Stewardship Commitment's GHG Intensity metric.



(Figure 1) Key steps in designing a GHG inventory

Greenhouse Gas Inventory

A GHG inventory provides a high-level perspective of a company's total emissions. A well-designed and maintained inventory can be used as a management tool upon which a variety of business goals can be achieved, such as increased brand recognition, participation in a voluntary reporting program, or setting and achieving GHG emissions reduction targets.

It is important to note that while an inventory can support a company's reporting goals, it is not to be confused with GHG emissions reporting, which is the presentation of emission data in formats tailored to the needs of various reporting requirements. Figure 1 outlines the steps taken to develop an inventory. Figure 2, page 3, outlines the key principles of a GHG inventory to ensure that the reporting information is industry-aligned through consistent reporting in the U.S. Dairy Stewardship Commitment.

GHG Inventory Guidance

Principles	Function
Relevance	• The boundaries of GHG emissions accounting and reporting should appropriately reflect the company's emissions and serve the business goals and decision-making needs of the company both internally and externally.
Completeness	• The emissions sources within the specified organizational and operational boundaries should be reported. NOTE: The GHG Protocol mandates that a company accounts for all its Scope 1 and 2 emissions within its organizational and operational boundaries. However, sources that are believed to be relatively small and/or insignificant may be calculated using "simplified" emissions calculation methods. These calculation methods are described in more detail in the *Minuscule Sources* section (page B-7) of The Climate Registry's General Reporting Protocol.
Consistency	• To ensure that emission data can be tracked and compared within the reporting company over time, consistent application of accounting practices and quantification methodologies is essential.
Transparency	• All information regarding the processes, assumptions and limitations of the inventory should be transparent and disclosed.
Accuracy	• Data collection should be as accurate as possible, and uncertainties should be avoided as far as practical.

(Figure 2) Principles and function of a GHG inventory from the GHG Protocol

Works Cited

1. EPA Center for Corporate Climate Leadership. March 8, 2024. Greenhouse Gas Inventory Guidance: http://bit.ly/2xNA2Fw
2. Climate Registry. May 2019. General Reporting Protocol for the Voluntary Reporting Program Version 3.0: https://bit.ly/3B4xPM7
3. EPA Center for Corporate Climate Leadership. August 2020. Simplified GHG Emissions Calculator: https://bit.ly/2Kh0T5r
4. Arnaud, B. *The Handbook of Carbon Accounting*, Routledge. 2016. Online.

Additional Resources

- Climate Registry. 2019. Page E-4: Third-Party Verification. General Reporting Protocol for the Voluntary Reporting Program Version 3.0: https://bit.ly/3B4xPM7
- World Resources Institute. Chapter 10. Verification of GHG Emissions. The GHG Protocol Corporate Accounting and Reporting Standard. (pp. 68): http://bit.ly/2yhHn0z

Inventory Management Plan

Chapter at a Glance

- Developing a Plan
- Implementing a Plan
- Overcoming Barriers

This chapter describes the development of an Inventory Management Plan (IMP), the systematic process of outlining the steps to create a credible and verifiable corporate-wide GHG inventory.

Developing an Inventory Management Plan

An Inventory Management Plan (IMP) should include the description of the managerial and technical responsibilities and arrangements made for collecting, calculating and maintaining GHG emission data.[1] Establishing and maintaining an accurate IMP allows for tracking decisions and changes over time, creates institutional knowledge of accounting procedures, and allows for more efficient and effective emissions accounting and reporting. To assist with the development or improvement of an IMP, companies can refer to the templates listed in the Additional Resources section at the end of the chapter.

The first step in developing an IMP is to consider how a GHG inventory will meet the company's goals. Dairy processing companies frequently cite the following GHG inventory goals:

- Identify GHG risks and reduction opportunities in the value chain.
- Identify cost-effective reduction opportunities.
- Participate in voluntary, mandatory and/or customer reporting programs.
- Acquire eco-labeling or certification.
- Set GHG emission reduction targets, measure progress toward targets and report outcomes to stakeholders.

Every reporting company will have a unique IMP that should incorporate the foundational components outlined in the previous section.

Implementing an Inventory Management Plan

Once the company objectives are established and the IMP is outlined, the reporting company can take steps to implement the IMP, which is further defined in Figure 3. The integration of an IMP into a company's operations can often be met with internal organizational barriers. To address this issue, see Additional Resources at the end of the chapter.

Steps for Implementing an Inventory Management Plan

1. Establish an Inventory Quality Team: This team is responsible for maintaining the GHG inventory program and coordinating interactions necessary for data collection and data validation.
2. Outline IMP Procedures: The plan should include procedures from initial data collection to final reporting. To ensure accuracy, the IMP should include practical measures for quality checks and documentation.
3. Perform Quality Checks: Internal quality checks should focus on data handling, documentation and emission calculations (e.g., ensuring that correct unit conversions are used consistently). Find guidance on quality assurance in the EPA Inventory Management Plan (IMP) Checklist.
4. Perform Source-Category Specific Quality Checks: This includes a more rigorous investigation of the application of boundaries, adjustment procedures and the quality of data used. This information can be used to support an uncertain assessment. Find guidance in the Climate Registry, General Reporting Protocol.
5. Establish Reporting, Documentation and Archiving Procedures: Establish record keeping procedures that specify what and how information will be documented and archived.

(Figure 3) Steps for implementing an Inventory Management Plan based on guidance from The Climate Registry, General Reporting Protocol

Works Cited

1. Climate Registry. May 2019. General Reporting Protocol for the Voluntary Reporting Program Version 3.0: https://bit.ly/3B4xPM7

Additional Resources

- GHG Protocol Corporate Accounting and Reporting Standard. Chapter 2, Business Goals and Inventory Design: http://bit.ly/2yhHn0z
- Climate Registry. General Reporting Protocol, Version 3.0: https://bit.ly/3B4xPM7

Resources for Developing an Inventory Management Plan

- The EPA Inventory Management Plan (IMP) Checklist. Outlines the necessary components that should be included in an IMP: http://bit.ly/2HWMfgo
- The GHG Protocol Reporting Template. A sample template meant to help outline the reporting requirements of the GHG Protocol Corporate Standard, but provides a good overview of what can be included in an inventory: http://bit.ly/2IdTDaH

Overcoming Internal Organizational Barriers

- The Virtuous Cycle of Strategic Energy Management. The Environmental Defense Fund (EDF), in collaboration with MIT Sloan School of Management, has created a framework for understanding how an organization can overcome internal barriers and drive corporate energy management initiatives: http://bit.ly/2whDbkN
- Smart Energy Best Practices Survey. Developed by EDF, the survey identifies bottlenecks and targets key opportunities to improve energy performance and cut emissions: http://bit.ly/2jykKyY
- Smart Energy Best Practices Rubric. Used along with the Smart Energy Best Practices Survey, this tool helps managers assess the overall health and progress of their GHG inventory program: http://bit.ly/2wgRqGH
- People Powered: Leveraging Employee Engagement to Accelerate Sustainability Efforts. A webinar hosted by EDF that discusses best practices in engaging employees around sustainability initiatives: http://bit.ly/2In7prC
- Energy Management Self-Assessment Tool. Carbon Trust tool that assesses your organization's current position with respect to energy management with an energy management matrix and assessment workbook: http://bit.ly/2whnWrY
- Employee Awareness and Office Energy Efficiency. Guide for employee engagement in office buildings, including energy-saving guides, employee engagement materials, posters and stickers: http://bit.ly/2NlxpUn

Greenhouse Gas Accounting Terminology

Chapter at a Glance

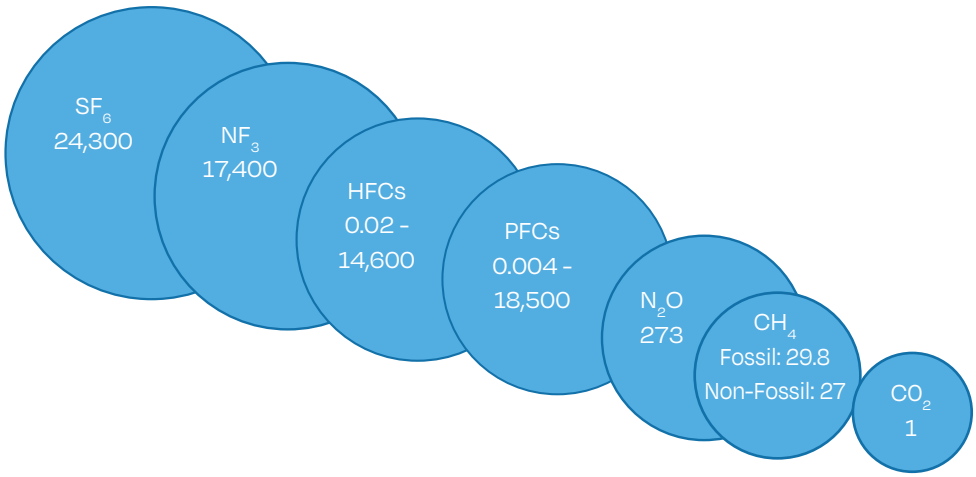
- Greenhouse Gases
- Global Warming Potential
- Carbon Dioxide Equivalent
- Emission Factors
- Activity Data

Greenhouse gas (GHG) emissions are estimated through the application of defined accounting principles. This chapter intends to provide an overview of commonly used terminology and concepts that are the foundation of GHG accounting.

Definitions

Greenhouse Gases	GHGs trap heat radiated from the sun in the atmosphere, warming the planet's surface. Many GHGs occur naturally in the atmosphere, but their increase in concentration from human activities has altered the Earth's radiative balance. For more information on GHGs and their interaction with Earth's atmosphere, refer to: • EPA's overview of Greenhouse Gases[1] • NASA, How Global Warming Stacks Up[2] • NASA, Temperature Puzzle[3] The GHG Protocol, Corporate Accounting and Reporting Standard covers the accounting and reporting of seven GHGs covered by the Kyoto Protocol: • Carbon dioxide (CO_2) • Methane (CH_4) • Nitrous oxide (N_2O) • Hydrofluorocarbons (HFCs) • Perfluorocarbons (PFCs) • Sulfur hexafluoride (SF_6) • Nitrogen trifluoride (NF_3)
Global Warming Potential	GHGs released into the atmosphere have different radiative effects depending on the unique qualities of the gas. The factor describing the radiative forcing impact of one unit of a given GHG relative to one unit of CO_2 is known as the Global Warming Potential (GWP). Since the amount of warming a gas causes over a given period (normally 100 years) varies, GHG emission calculations must account for the GWP of each gas. GWP is an index with CO_2 having an index value of 1. The GWP for all other GHGs refers to the amount of warming they cause compared to CO_2. For instance, the radiative forcing impact of one unit of methane (CH_4) is 28 times more powerful than one unit of CO_2. (Figure 4, page 7) The GHG Protocol and the majority of accounting standards use GWP values established by the Intergovernmental Panel on Climate Change (IPCC). The IPCC updates GWP values as scientific understanding develops and the Sixth Assessment Report (AR6) contains the most recent values.

Definitions - continued

Global Warming Potential	By default, the GHG Protocol calculation tools are set to calculate emissions using AR6. The following guidelines can assist reporting companies in using GWP values and are drawn from the GHG Protocol IPCC Global Warming Potential Values. The reporting company should: • Use 100-year GWP values from the IPCC. • Use GWP values from the most recent IPCC assessment report (currently the Sixth Assessment Report), unless requirements of a specific reporting program differ. • Use the same GWPs for the current inventory period and the base year as well as for inventories prepared according to the Scope 3 Standard to maintain consistency across time and scopes. • Report the source of the GWP values and indicate if multiple IPCC assessment reports have been used.  *(Figure 4) The Global Warming Potential of IPCC recognized GHGs, AR6*
Carbon Dioxide Equivalent	Carbon dioxide equivalent (CO_2e) is the standard unit used to compare and account for emissions from various GHGs based on their global warming potential. For instance, Figure 4 illustrates that CO_2 has a GWP of 1 and non-fossil based CH_4 (methane) has a GWP of approximately 27 (on a 100-year time horizon). Therefore, for every tonne of CH_4 emitted, an equivalent of 27 tonnes of CO_2 would be emitted. Since one tonne of a particular GHG is not the same GWP as one tonne of another, this standard unit is a simple way to normalize and express GHGs as an equivalent of CO_2.
Emission Factors	An emission factor is used to calculate the GHG emissions for a given source, relative to units of activity. Emission factors reflect average values by sector, technology type, and/or fuel type. For example, eGRID emission factors for electricity use in the NPCC New England sub region indicate that for every MWh of electricity consumed, 563.7 lbs. of CO_2e are emitted. This emission factor can be used to determine the total CO_2e emissions resulting from the company's purchased electricity in that region. To maximize accuracy, it is important to select emission factors that are appropriate for the relevant context. The default emission factors embedded in the referenced calculators are updated and relevant to the calculation context of the tool. A full list of the emission factors can be found in the US EPA Center for Corporate Climate Leadership: Emission Factors for Greenhouse Gas Inventories.

Definitions - continued

Activity Data

Activity data is a key input for the calculation of GHG emissions and refers to the data associated with an activity that generates GHG emissions, such as gallons of gasoline consumed from company cars. This activity data is collected in physical units (gallons) or energy units (therms) and then combined with an emissions factor and the relevant greenhouse gas GWP value to calculate CO_2e.

The collection of activity data is the primary responsibility of the reporting company and will often be the most significant challenge when developing a GHG inventory. Therefore, establishing robust activity data collection procedures is essential. The following measures are useful for ensuring the collection of quality activity data:

Steps for Gathering Activity Data

1. Convert fuel consumption data from physical to energy units.
   - The Energy Information Administration has a conversion tool to easily convert different fuels to energy content.

   NOTE: If reporting into the Aggregate Reporting Tool, energy data should be reported in volume/mass units (i.e., gallons of fuel, therms of gas). The conversion from volume/mass to energy is done automatically using a predetermined energy factor.

2. Develop data collection procedures in the IMP to standardize collection practices.
3. Compare current year data with historical trends to identify inconsistent changes that are over 10 percent. Inconsistencies should be investigated.
4. Compare activity data from multiple reference sources (e.g., government survey data or data compiled by other dairy processing companies) with company data when possible.

Works Cited

1. EPA. 2017. Understanding Global Warming Potentials: http://bit.ly/2gXtxJF
2. World Resources Institute. The GHG Protocol Corporate Accounting and Reporting Standard. 2013. Required Greenhouse Gases in Inventories, accounting and reporting standard amendment: https://bit.ly/3ZGmYkE
3. Climate Registry. May 2019. General Reporting Protocol for the Voluntary Reporting Program Version 3.0: https://bit.ly/3B4xPM7

Additional Resources

Greenhouse Gases

- EPA Overview of Greenhouse Gases. http://bit.ly/2ro6lU4
- NASA Global Climate Change, How Global Warming Stacks Up. A three-minute video that explains how different factors contribute to global warming: https://go.nasa.gov/2JXkvsp
- NASA Global Climate Change, Temperature Puzzle. A five-minute video that explains the impacts of the sun's energy, Earth's reflectance and greenhouse gasses on global warming: https://go.nasa.gov/2rpUt9T

Global Warming Potential

- EPA, Understanding Global Warming Potentials. http://bit.ly/2gXtxJF
- Intergovernmental Panel on Climate Change. https://www.ipcc.ch/
- GHG Protocol, Global Warming Potential Values. Table of GWPs from the SAR, AR4 and AR6 report: https://bit.ly/3D1ncu0

Emission Factors

- GHG Protocol, Emission Factors from Cross Sector Tools. 2017: http://bit.ly/2q3eZzN

Establishing Inventory Boundaries

Chapter at a Glance

- Organizational Boundaries
- Operational Boundaries

This chapter describes the role of and process for developing GHG inventory boundaries. Inventory boundaries determine which business operations and emissions will be accounted for in a company's GHG inventory. Organizational boundaries define the operations and facilities included in the inventory, while the operational boundaries categorize the emissions resulting either directly or indirectly from the organization's operations and facilities.

Supporting Resources

This section of the document draws on guidance from the following resources:

Organizational Boundaries:

- GHG Protocol Corporate Accounting and Reporting Standard, Revised Edition. Chapter 3, Setting Organizational Boundaries[1]
- General Reporting Protocol, Version 3.0. Chapter B, Inventory Boundaries[2]

Operational Boundaries:

- GHG Protocol Corporate Accounting and Reporting Standard, Revised Edition. Chapter 4, Setting Operational Boundaries[3]
- General Reporting Protocol, Version 3.0. Chapter B, Inventory Boundaries[4]

Organizational Boundaries

Organizational boundaries are generally high-level boundaries that determine which business operations and facilities are part of the GHG inventory. Due to differences in legal and organizational structures, each company's organizational boundary will vary. The GHG Protocol outlines three approaches for developing organizational boundaries — the Equity Share, the Operational Control and the Financial Control Approach (Figure 6). It is important to note that these different boundary approaches need to be applied independently. Furthermore, a reporting company should use the same approach for all Scope 1 and 2 emissions categories when compiling a GHG emissions inventory and use this same approach for subsequent reporting periods to ensure consistency when tracking emissions over time.

NOTE: A reporting company that wholly owns and controls its operations is responsible for all associated emissions. In this case, the outcome will be the same whichever approach is used.[5]

Equity Share Approach

The reporting company accounts for GHG emissions that are wholly or partially owned according to its share of equity in that operation, regardless of whether operational or financial control is exerted.

Operational Control Approach

The reporting company accounts for 100 percent of emissions from operations over which it or one of its subsidiaries has operational control. However, it should be emphasized that having operational control does not mean that a company necessarily has the authority to make all decisions concerning an operation. Therefore, a company may report emissions from a leased asset as Scope 3 if the company can demonstrate and state clearly the reasons that it does not have operational control (GHG Protocol, Appendix F, 2006).

Financial Control Approach

The reporting company accounts for 100 percent of emissions from operations over which it or one of its subsidiaries has financial control.

If a reporting company is applying the Operational or Financial Control approach, it does not need to account for emissions arising from operations over which it does not control.

Lessee's/Tenant's Perspective		
	Capital Lease	Operating Lease
Operational Control Approach	Lessee has control/ownership (S1 or 2)	
Financial Control or Equity Share Approach	Lessee has control/ ownership (S1 or 2)	Lessee does NOT have control/ ownership (S3)

(Figure 6) Categorizing emissions from leased assets by scope based on lease type and organizational boundary approach used. Note: "S" refers to the Scope.

Categorizing GHG Emissions with Leased Assets

Many companies lease assets from other companies. The accounting for leased assets (whether the emissions are Scope 1, 2 or 3) depends on two factors – the organizational boundary approach used and the type of leased asset. The GHG Protocol's Appendix: "Categorizing Emissions from Leased Assets", details the correct accounting methodology based on the type of leased asset and organizational boundary approach used.

NOTE: Reviewing a company's statement of values can be a good place to start when identifying company-owned assets. Once the assets within the defined boundary are identified, maintain an up to date list of company-owned facilities as part of the IMP.

Operational Boundaries

Operational boundaries are defined by "scopes," which categorize the emissions resulting either directly or indirectly from the company's operations and activities. Figure 7 describes the most common sources of emissions in dairy processing.

Scope 1

Scope 1 direct emissions occur from sources owned or controlled by the company. In dairy processing, most Scope 1 emissions are from stationary combustion. However, mobile emissions, process emissions and fugitive emissions are also counted as Scope 1 if the company owns or controls the activities or equipment associated with the emissions.

Scope 2

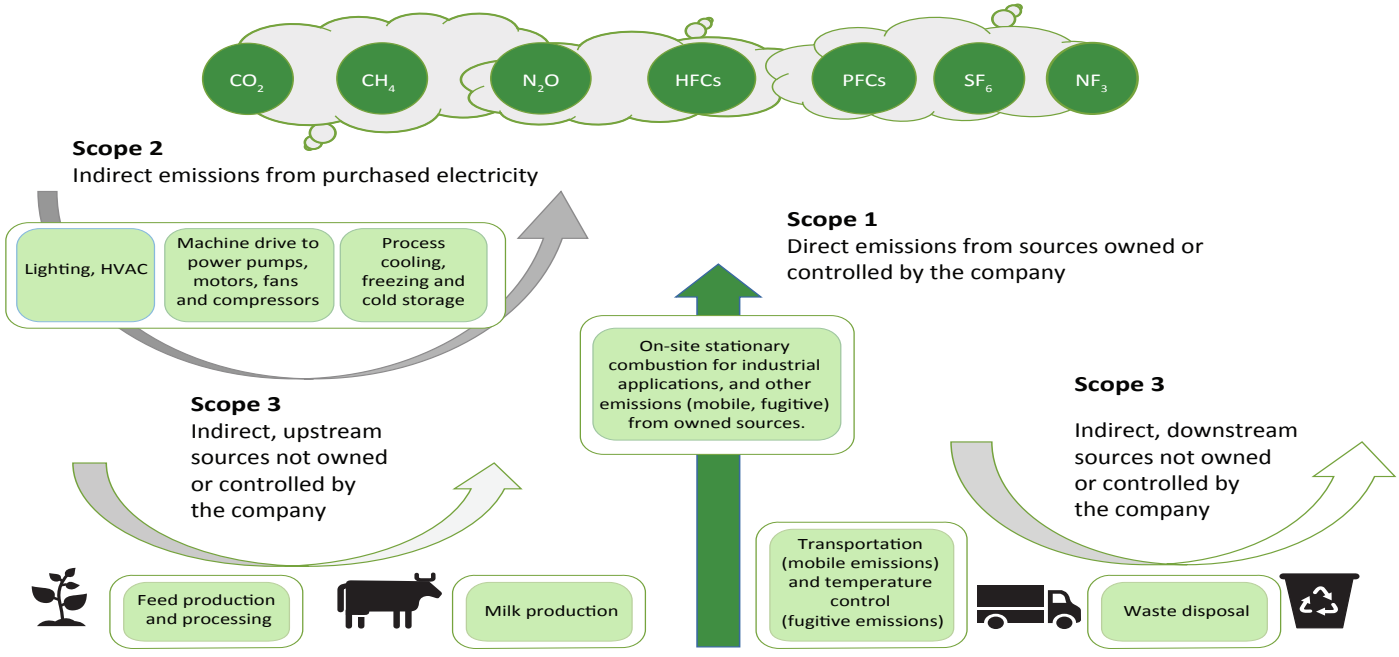
Scope 2 indirect emissions are from the generation of purchased energy. The emissions resulting from the production of grid electricity are accounted for under Scope 2. One of the primary uses of purchased electricity in dairy processing is for process cooling, freezing and cold storage. Electricity is also used to drive process motors, fans, pumps, compressed air systems, facility lighting and facility HVAC.[6]

Scope 3

Scope 3 indirect emissions are a result of an organization's operations, but are not owned or controlled by the company.

Biogenic Methane and Nitrous Oxide Emissions

Sources of biogenic methane (CH_4) and biogenic nitrous oxide (N_2O) should be accounted for as Scope 1 process emissions. A common, yet relatively minimal, source of biogenic nitrous oxide emissions in dairy processing arises from land spreading, a process in which nitrogen-rich wastewater is recycled to be used as fertilizer on local farms. Nitrous oxide (N_2O) is naturally produced in soils through the microbial processes of nitrification and denitrification. The nitrogen in the wastewater increases mineral nitrogen availability, resulting in both indirect and direct N_2O emissions at the site.



(Figure 7) Common Scope 1, 2 and 3 emission sources in the dairy processing industry

Calculating the N_2O emissions from land spreading requires two sources of processor input data: annual gallons of wastewater and the average wastewater. Average wastewater is measured by Total Kjehldahl Nitrogen content (TKN), which is calculated as mg N/L wastewater. The input data can be applied to an equation outlined in the 2016 Field to Market Environmental and Socioeconomic Indicators for Measuring Outcomes of On-Farm Agricultural Production in the United States.[7]

This is consistent with a Tier 1 approach as recommended by the Intergovernmental Panel on Climate Change (IPCC). The IPCC default value for total direct and indirect nitrous oxide emissions represents about 1.4 percent of the applied nitrogen from fertilizer. To convert emissions from applied nitrogen to CO_2e, apply the molecular weight of nitrous oxide (44/28) and the N_2O Global Warming Potential (GWP further described on page 7) value of 273. The equation for estimating the Scope 1 process emissions from land spreading is detailed in the box denoted, Field to Market Equation for Estimating Land Spreading Emissions.

Field to Market Equation for Estimating Land Spreading Emissions

Lbs. N applied = (Total gallons of wastewater applied) X (3.785 L/gal.) X (0.002 lbs./g) X (0.001 g/mg.) X Total Kjehldahl Nitrogen content (mg N/L wastewater)

Lbs. CO_2e = (lbs. N applied / 100) X 1.4 percent X (44/28) X 273

While CH_4 and N_2O biogenic emissions are reported within Scope 1, CO_2 emissions arising from biogenic sources (i.e., biomass combustion) are reported independently from the "scopes." More specifically, a reporting company (to the extent allowed by available data) should account for biogenic CO_2 emissions in a separate memo item appended to the rest of the GHG inventory.

Works Cited

1. World Resources Institute. Chapter 3, Setting Organizational Boundaries. GHG Protocol Corporate Accounting and Reporting Standard, Revised Edition. (pp 16-23): http://bit.ly/2yhHn0z
2. The Climate Registry. Chapter B, Inventory Boundaries. General Reporting Protocol: https://bit.ly/3B4xPM7
3. The Climate Registry. Chapter B, Inventory Boundaries. General Reporting Protocol: https://bit.ly/3B4xPM7
4. Climate Registry. May 2019. General Reporting Protocol for the Voluntary Reporting Program Version 3.0: https://bit.ly/3B4xPM7
5. World Resources Institute. GHG Protocol Corporate Accounting and Reporting Standard, Revised Edition: http://bit.ly/2yhHn0z
6. EPA, Energy Star. 2011. Energy Efficiency Improvement and Cost Saving Opportunities for the Dairy Processing Industry: https://bit.ly/3ZCSoIU
7. Field to Market. Part One: Environmental Indicators. Environmental and Socioeconomic Indicators for Measuring Outcomes of On-Farm Agricultural Production in the United States: https://bit.ly/3DaSTks

Scope 1: Stationary Combustion

Chapter at a Glance

- Identify Sources
- Collect Activity Data
- Quantify Emissions
- Ensure Quality Control

This section provides guidance on calculating Scope 1, direct GHG emissions from stationary combustion. Stationary fuel combustion emission sources are typically devices that combust solid, liquid or gaseous fuel, generally for the purposes of producing electricity, generating steam or heat for dairy processing purposes.

Supporting Resources

In addition to the GHG Protocol Corporate Accounting and Reporting Standard, this section of the document includes guidance from the following resources:

- EPA GHG Inventory Guidance Direct Emissions from Stationary Combustion Sources[1]
- Environmental Protection Agency. General Stationary Combustion Source (Subpart C), Calculating CO_2 Emissions from Combustion. EPA, Greenhouse Gas Reporting Program[2]
- US EPA Center for Corporate Climate Leadership: Emission Factors for Greenhouse Gas Inventories[3]

1

Identify Sources: Most emission sources from stationary combustion in dairy processing include — but are not limited to — boilers, combustion turbine process heaters and generators. Emission sources can be identified by creating a questionnaire requesting information about the types of fuels used for on-site stationary combustion at the facility, how fuel consumption is tracked, and the name and contact information of the energy providers. Figure 8 summarizes the most common stationary combustion sources and fuels.

Stationary Combustion Sources and Fuels

Stationary Combustion Sources	Common Fuels Used
Boiler	Natural gas, Fuel oil, Propane, Diesel
Combustion Turbines	Fuel oil, Coal, Propane, Kerosene
Process Heaters	Natural gas, Propane
Incinerators	Natural gas, Propane

(Figure 8) Common stationary combustion sources and fuels in dairy processing

2

Collect Activity Data: The activity data required for this calculation includes the amount of fuel consumed for each of the stationary combustion sources and the fuel characteristics of each type of fuel used.

Fuel Consumption: Collect data on the quantity of fuel consumed for combustion purposes. Two calculation methods are outlined below. The most common method for dairy processing facilities is the use of purchase records:

- On-site metering: The mass or volume flow of fuel at the input point to one or more combustion units. This data can be gathered using measurement equipment such as scales or flow meters.
- Purchase records: The mass or volume of fuel entering the facility. This data can be based on fuel receipts, purchase records or data provided directly from the energy vendor and /or customer online portal.

Fuel Characteristics: Determine the emission factor data based on the characteristics of the fuel combusted at each identified source. Three methods are outlined below and on page 18, with the most common approach for dairy processing facilities being the use of actual fuel heating values or default heating values.

NOTE: Aggregate Reporting Tool users only need to enter fuel consumption volume. The subsequent steps are automatically performed by the Tool.

continued on next page

Scope 1: Stationary Combustion

2

- Measured carbon content: This is a measure of the total carbon in the fuel and can be determined through chemical analysis. This is the most accurate emission factor data, but it is often not practical for dairy processors to conduct a fuel analysis.

NOTE: Fuel metering equipment and readings are subject to error. Therefore, if this method is chosen, calibration and testing should be performed to ensure accuracy.

- Actual fuel heating value: A fuel's heating value is a measure of the quantity of heat liberated during combustion of the fuel. This information can often be found on utility bills which will list the amount of fuel purchased in terms of energy. For instance, most natural gas consumption data is detailed in thermal units and volumetric units. To ensure consistent reporting, all energy values should be reported in Gross Calorific Value (GCV) where the high heat value (HHV) is reported.
- Default heating values: If it is not practical to obtain data specific to fuel used, then default heating values embedded in the Aggregate Reporting Tool will be applied to calculate emissions.

Quick Tip Tip: Emission factors and default high heating values are representative averages based on multiple fuel samples taken across the country. For homogeneous fuels, such as pipeline-quality natural gas, default heating values often provide a very accurate emissions estimate.

3

Quantify Emissions: Calculate Scope 1 stationary combustion emissions using the EPA Simplified GHG Emissions Calculator. Use the EPA GHG Inventory Guidance Direct Emissions from Stationary Combustion Sources[1] In conjunction with the calculator.

The tool is effective in calculating CO_2e emissions resulting from the combustion of fuels in stationary combustion equipment. (Figure 9 highlights the key features of the tool. Figure 10, page 15, offers additional guidance on using the tool.)

Overview of Stationary Combustion Emissions Calculator	
Feature	Description
Emission Calculations	Calculates CO_2, CH_4 and N_2O emissions resulting from the combustion of fuels in stationary combustion equipment. Total emissions in tons of CO_2e.
Unit Conversion	Automatically converts data to common measurement units. If certain units are available, use the EIA Energy Conversion Calculator[3] to first convert the units.

(Figure 9) Stationary combustion emissions calculator tool highlights

Additional Guidance for use of the Calculation Tool

- If fuel consumption data is recorded in physical units and the heat value is known, convert fuel consumption data to energy units.

NOTE: Aggregate Reporting Tool users should not follow this step. A default heat value for each fuel type is embedded in Intelex. Certain energy types such as natural gas, solar and wind can be reported directly in energy units.

- Under the "Introduction" tab, supply information on the type of fuel consumed and select the industry sector – "Manufacturing."

continued on next page

Scope 1: Stationary Combustion

3

- If using energy units, the user is required to select High Heating Value (HHV) or Low Heating Value (LHV). To maintain consistency with the Processor Handbook, processors should try to use HHVs.
  - High Heating Value (HHV) is defined as the amount of heat released by a specified quantity (initially at 25°C) once it is combusted and the products have returned to a temperature of 25°C, which takes into account the latent heat of vaporization of water in the combustion products.
  - Low Heating Value (LHV) is defined as the amount of heat released by combusting a specified quantity (initially at 25°C) and returning the temperature of the combustion products to 150°C, which assumes the latent heat of vaporization of water in the reaction products is not recovered.
- For additional information on heating values and guidance on calculating the emissions of biomass fuels, emergency generators, waste-derived fuels, CO_2 capture and storage, and non-combustion sources, refer to the EPA's GHG Inventory Guidance, Direct Emissions from Stationary Combustion Sources.

4

Ensure Quality Control: The accuracy and transparency of an emissions calculation depends on the quality of the data collected, the rigor of quality control measures, and proper documentation. Figure 10 highlights a few key quality control measures. Figure 11 provides documentation guidelines. Additional documentation information can be found in Chapter 7 of the GHG Protocol Corporate Accounting and Reporting Standard.

Quality Control Guidelines	
Step 1	If using meters to collect activity data, compare fuel-metered data with purchase records to ensure accuracy of metering equipment.
Step 2	Ensure consistent emission factors and GWPs are used across facilities.
Step 3	Conduct an internal review to ensure units were converted correctly and emissions were accurately quantified.
Step 4	If not using default emissions factors, compare actual heating values to available default values.
Step 5	Update the IMP to reflect any changes in monitoring equipment or procedures that could potentially affect the quality of emissions data.

(Figure 10) Key quality control guidelines for stationary combustion emissions calculations

Documentation Guidelines
• Description of facilities and stationary combustion sources and fuels
• Description of methods applied to estimate emissions for each activity, facility and combustion unit
• List of metering or monitoring devices used (if applicable)
• Information on the source(s) used to calculate the activity data. This could include: purchase receipts, utility bills, delivery receipts, contract purchase, on-site metered fuel documentation, stock inventory documentation and heat content documentation from suppliers.
• Description of quality management procedures implemented
• Summary of any changes that may have affected the accuracy, consistency or completeness of calculations

(Figure 11) Scope 1, Stationary Combustion emissions documentation guidelines

Scope 1: Stationary Combustion

Works Cited

1. EPA Center for Corporate Climate Leadership. Greenhouse Gas Inventory Guidance Direct Emissions from Stationary Combustion Sources. Version 3.0: http://bit.ly/2KJrg2a
2. World Resources Institute. May 2015. GHG Protocol Guidance Direct Emissions from Stationary Combustion, Version 3.0: http://bit.ly/2gX1WbG
3. Environmental Protection Agency. General Stationary Combustion Source (Subpart C), Calculating CO_2 Emissions from Combustion. EPA, Greenhouse Gas Reporting Program: http://bit.ly/2FPuNso
4. EPA Center for Corporate Climate Leadership. Emission Factors for Greenhouse Gas Inventories. June, 2024. https://www.epa.gov/system/files/documents/2024-02/ghg-emission-factors-hub-2024.pdf
5. Environmental Protection Agency. Direct Emissions from Stationary Combustion Sources, Greenhouse Gas Inventory Guidance. January 2016: http://bit.ly/2KJrg2a

Additional Resources

- World Resources Institute GHG Protocol Tool for GHG Emissions from Stationary Combustion. http://bit.ly/36c227z
- World Resources Institute. GHG Protocol Stationary Combustion Guidance, Version 3.0: http://bit.ly/2gX1WbG
- Energy Conversion Calculators. Used to convert physical units to energy units: https://bit.ly/33M6f04
- EPA Center for Corporate Climate Leadership. Greenhouse Gas Inventory Guidance Direct Emissions from Stationary Combustion Sources. Version 3.0: http://bit.ly/2KJrg2a

Scope 1: Fugitive Emissions

Chapter at a Glance

- Identify Sources
- Collect Activity Data
- Select Approach
- Ensure Quality Control

Fugitive emissions from refrigeration and air conditioning result from leakage and service over the operational life of the equipment and from disposal at the end of the useful life of the equipment. The leakage of refrigerant gas is a small but significant source of GHG emissions because of the high GWP associated with these GHGs.

Supporting Resources

In addition to the GHG Protocol Corporate Accounting and Reporting Standard, this section of the document draws on guidance from the following resources:

- EPA GHG Inventory Guidance, Direct Fugitive Emissions from Refrigeration, Air Conditioning, Fire Suppression, and Industrial Gases[1]
- Climate Registry General Reporting Protocol Version 3.0, Page C-17: Direct Fugitive Emissions[2]

Alternatively, companies that report through the Processor Aggregate Reporting Tool have the option to utilize Harbor's Refrigerant App to calculate fugitive leak rates necessary to calculate GHG emissions. The Refrigerant App is a supplementary tool in the Processor Aggregate Reporting Tool that quantifies refrigerant-based emissions using product type-specific information via the screening method. The App then applies these emissions to a company's total Scope 1 footprint in the Aggregate Reporting Tool automatically.

Companies that have not opted into the Processor Reporting, LLC do not have access to the Refrigerant App but may still consult this guidance to calculate their Scope 1 fugitive emissions.

NOTE: HFCs and PFCs are a class of powerful greenhouse gases with GWP values that are typically 1,000 times greater than CO_2. Since these GHGs have a significant warming ability, careful attention should be given to thoroughly account for and quantify fugitive emissions. The significance of an emissions source in a company's IMP can only be established after it has been appropriately assessed and quantified.

1

Identify Sources: Most dairy processing facilities use non-halogenated refrigerants such as ammonia, propane and isobutane for refrigeration. These refrigerants are not GHGs and, therefore, are not reported in the inventory. However, HFC and PFC refrigerants used in refrigerated trailers and air conditioning units are common, and the associated GHG emissions should be accounted for in company-owned and -controlled equipment. Figure 12 lists fugitive emission sources that are common in dairy processing.

Common Fugitive Emission Sources
Refrigerated transport
Industrial process refrigeration
Cold storage warehouses
Mobile air conditioning

(Figure 12) Common sources of fugitive emissions in dairy processing

2

Collect Activity Data: The activity data required to calculate fugitive emissions depends upon the calculation approach selected in Step 3.

Scope 1: Fugitive Emissions

3

Quantify Emissions: Calculate fugitive emissions by using the 'Refrigeration and AC' tab on the EPA Simplified GHG Emissions Calculator. The Aggregate Reporting Tool quantifies fugitive emissions according to the Mass Balance method (Option 1) in the Calculator. Use this calculator in conjunction with the EPA Fugitive Emissions Guidance.

Overview of Fugitive Emission Calculation Methods

Method	Description	Best Use
Screening Method	A preliminary method to estimate emissions	Use only if fugitive emissions are relatively small. If emissions are estimated or believed to be relatively large, the company should use a more accurate and robust method, as the emissions factors used in this method are highly uncertain.
Sales-Based Method	Activity data based on purchase records and service records	For companies that maintain their own refrigerant equipment: emissions are based on the amount of refrigerant purchased and used by the facility.
Lifecycle Stage Method (Mass Balance Method)	Activity data based on total inventory of refrigerants	For companies that have contractors maintain equipment: tracks emissions from installation, servicing and disposal.

(Figure 13) Calculation methods for quantifying fugitive emissions from refrigeration and air-conditioning equipment

4

Ensure Quality Control: Implementing quality control measures and documentation measures are important for fugitive emissions calculations, as failure to account for small releases of fluorinated compounds can lead to significant errors in a company's GHG inventory. Additional information can be found in Chapter 7 of the GHG Protocol Corporate Accounting and Reporting Standard and Section 7 of the EPA Fugitive Emissions Guidance.

Quality Control and Documentation for Fugitive Emission Calculations

- Account for each GHG emissions source separately because of the differing GWPs.
- Provide information on the approach used to quantify direct fugitive emissions.
- Identify calculation errors and omissions by comparing facility emissions data against previous year calculations.
- Document activity data — stock inventory documentation, purchase receipts, delivery receipts, contract purchases, delivery receipts of equipment, shipping or disposal records of equipment.
- Identify areas of uncertainty in emission calculations and use the most accurate data or conservative values.

(Figure 14) Quality control and documentation guidelines for fugitive emissions calculations

Scope 1: Fugitive Emissions

Works Cited

1. EPA Center for Corporate Climate Leadership. Greenhouse Gas Inventory Guidance Direct Fugitive Emissions from Refrigeration, Air Conditioning, Fire Suppression, and Industrial Gases: http://bit.ly/2KHZgMn
2. Climate Registry. May 2019. General Reporting Protocol Version 3.0, Page C-17: Direct Fugitive Emissions: https://bit.ly/3B4xPM7

Additional Resources

- World Resources Institute GHG Protocol Tool for Refrigeration and Air-Conditioning Equipment. http://www.ghgprotocol.org/sites/default/files/ghgp/hfc-pfc_0.xls
- World Resources Institute. January 2005. GHG Protocol HFC Guide to Calculation Worksheets, Version 1.0: http://bit.ly/2jCgwXg
- World Resources Institute. GHG Protocol Corporate Accounting and Reporting Standard, Chapter 7: Managing Inventory Quality: http://bit.ly/2yhHn0z

Scope 1: Mobile Combustion Emissions

Chapter at a Glance

- Identify Sources
- Collect Activity Data
- Select Approach
- Ensure Quality Control

This section provides guidance on accounting for and calculating Scope 1 direct GHG emissions from owned or leased mobile sources (both on-road and non-road vehicles) that are within the company's inventory boundaries.

Supporting Resources

This section of the document includes guidance on the following resources:

- EPA Center for Corporate Climate Leadership, Greenhouse Gas Inventory Guidance Direct Emissions from Mobile Combustion Sources.[1]
- The Climate Registry, General Reporting Protocol Version 3.0, Page C-5: Direct Emissions from Mobile Combustion[2]

1

Identify Sources: Scope 1 mobile emissions refer to a wide variety of company-owned or operated vehicles, engines and equipment that generate GHG emissions through the combustion of various fuels while moving from one location to another. They include vehicles used on roads for transportation of employees or distribution trucks as well as off-road vehicles, engines and equipment used for many other purposes. Equipment that can not move under its own power but can be transported site-to-site (e.g., an emergency generator) is defined as a stationary (not mobile) combustion source.[1] Owned company product distribution trucks are most likely the greatest sources of mobile emissions for dairy processors. However, if the processing company does not own or have direct operational control of vehicles or equipment, these sources will be reported as Scope 3, not Scope 1 emissions. A list of common mobile combustion emission sources can be found in Figure 15.

Mobile Emission Sources		
Common Mobile Combustion Sources		Common Fuels Used
On-Road Vehicles	Company vehicles	Gasoline
	Combination trucks and fluid milk trucks	Diesel fuel, gasoline, biodiesel
Non-Road Vehicles (Mobile Machinery)	Forklifts and non-road equipment	Gasoline, diesel fuel, propane
	Construction equipment	Diesel fuel

(Figure 15) Common mobile emission sources and fuels used in dairy processing

2

Collect Activity Data: GHG emissions from mobile combustion are most easily estimated by collecting data on the amount of fuel consumed, distance traveled and vehicle and fuel characteristics for each identified source. Figure 16, page 21 outlines the necessary activity data to perform this calculation.

Quick Tip TIP: If all the preferred activity data is not available, the company should, at a minimum, provide fuel consumption data. The referenced calculation tool will auto populate default emission factors for missing data.

continued on next page

Scope 1: Mobile Combustion Emissions

2

Activity Data for Mobile Emission Calculations	
Type	Data Needed
Fuel Consumption	Number of gallons, barrels, cubic meters, etc.
Distance Traveled	Number of miles, kilometers
Vehicle Characteristics	Vehicle type and model year
Fuel Characteristics	Type of fuel and heating value

(Figure 16) Activity data that should be collected for each source of mobile combustion emissions

3

Quantify Emissions: Use the EPA Simplified GHG Emissions Calculator, 'Mobile Sources' tab to quantify emissions from mobile combustion. Refer to the EPA Direct Emissions from Mobile Combustion Sources for guidance on this category.

This tool calculates the CO_2, CH_4 and N_2O emissions of:

- Vehicles that are owned/controlled by the company
- Transport by road, rail, air and water
- Mobile machinery, such as agricultural and construction equipment

4

Ensure Quality Control: The quality control and documentation guidelines outlined in Figure 17 can help to ensure data accuracy and transparency. For more information about reducing uncertainty when calculating emissions from mobile sources, refer to Section 6 of the EPA Direct Emissions from Mobile Combustion Sources.

Quality Control and Documentation for Mobile Emission Calculations
• Compare emission factors provided by fuel supplier or collected on-site with the EPA Center for Corporate Climate Leadership: Emission Factors for Greenhouse Gas Inventories.
• Document fuel consumption data with official logs of vehicle gauges, fuel purchase receipts and storage tank records.
• Document distance traveled with odometer logs and calculated miles to destination.
• Document vehicle fuel economy with company records, manufacturer records or with information from the EPA fuel economy website.

(Figure 17) Quality control and documentation for mobile emission calculations

Scope 1: Mobile Combustion Emissions

Works Cited

1. The Climate Registry. May 2019. Glossary of terms. General Reporting Protocol Version 3.0: https://bit.ly/3B4xPM7
2. EPA Center for Corporate Climate Leadership. January 2016. Greenhouse Gas Inventory Guidance Direct Emissions from Mobile Combustion Sources: http://bit.ly/2JZ4lip
3. The Climate Registry. May 2019. Page C-5: Direct Emissions from Mobile Combustion. General Reporting Protocol Version 3.0: https://bit.ly/3B4xPM7
4. World Resources Institute. 2015. Setting Operational Boundaries. The GHG Protocol Corporate Accounting and Reporting Standard. (pp. 25): http://bit.ly/2yhHn0z

Additional Resources

- World Resources Institute GHG Protocol Tool for Mobile Combustion. Version 2.6: http://bit.ly/2qSGWuV
- EPA Center for Corporate Climate Leadership. Greenhouse Gas Inventory Guidance Direct Emissions from Mobile Combustion Sources: http://bit.ly/2JZ4lip
- WRI GHG Emission Factors Compilation. A spreadsheet of emission factors used in the GHG Protocol Calculators: https://bit.ly/2NFLq0M
- EPA and U.S. Department of Energy. Official U.S. government source for fuel economy information: https://www.fueleconomy.gov/feg/findacar.shtml
- EPA Center for Corporate Climate Leadership. Chapter 6, Uncertainty Assessment. Greenhouse Gas Inventory Guidance Direct Emissions from Mobile Combustion Sources: http://bit.ly/2JZ4lip
- Environmental Defense Fund, Climate Corps Handbook. Chapter 15, Energy Consumption of Company Vehicles: http://bit.ly/2MTc9GB

1. Climate Registry. May 2019. General Reporting Protocol Version 3.0, Page C-17: Direct Fugitive Emissions: https://bit.ly/3B4xPM7

Scope 2: Emissions from Purchased Energy

Chapter at a Glance

- Identify Sources
- Collect Activity Data
- Select Approach
- Ensure Quality Control

This section presents methods used to calculate Scope 2 GHG emissions, which are indirect emissions from the generation of purchased energy. These are considered an indirect emissions source because they are a consequence of activities of the reporting organization but occur at sources owned and controlled by an outside entity (i.e., an electricity utility).

Supporting Resources

In addition to the GHG Protocol, this chapter draws on guidance from the following resources:

- EPA, Center for Corporate Climate Leadership, Indirect Emissions from Purchased Electricity[1]
- The GHG Protocol Scope 2 Guidance: An amendment to the GHG Protocol Corporate Standard[2]
- The Climate Registry General Reporting Protocol, Pages C-9 - C-16[3]

Defining Scope 2 Emissions

The GHG Protocol Scope 2 Guidance Amendment to the Corporate Standard, which went into effect in January 2015, provides updated requirements and best practices for Scope 2 emissions accounting. The updates were made to reflect changes in electricity markets and the growing choices companies have regarding the type of electricity purchased. The most significant Scope 2 accounting change introduced is that companies are to account for and report Market-Based and Location-Based Scope 2 emissions. Previously, the protocol only required the Location-Based method.

Market-Based Emissions

The Market-Based method reflects the GHG emissions associated with the specific choices a consumer (a dairy processor) makes regarding its electricity supplier or product, as conveyed through contractual agreements between the processor and the provider. The emission factors are supplier-specific emission factors, or the emissions profiles associated with renewable energy credits (RECs) and power purchase agreements (PPAs).

Location-Based Emissions

The Location-Based method uses average emission factors for the electricity grids that are providing electricity to the facility.[4] That is, the Location-Based approach considers average emissions intensities in the locations of electricity use, while the Market-Based approach considers the emissions intensities of electricity products that the processor has specifically chosen.

Calculating Scope 2 Emissions

When calculating Scope 2 emissions, companies should do the following:

- Companies should report both Market-Based and Location-Based Scope 2 emissions totals.
- When a company enters into a supplier-specific contract (or another contract) in which a credible emission factor is unidentifiable, the reporting company should simply use the grid-average emission factor as a proxy for that specific amount of contracted energy.
- All instruments must meet certain quality criteria before they can be applied to the Market-Based emissions total. These criteria are listed on page 60 of the GHG Protocol's Scope 2 Guidance.

A reporting company should select either the Location-Based approach or Market-Based approach when setting a Scope 2 target and tracking its performance.

Since the predominant Scope 2 calculation method currently used across the dairy processing sector is the Location-Based method, this document describes steps to calculate Location-Based emissions outlined in Figure 18, page 24.

Scope 2: Emissions from Purchased Energy

Scope 2: Steps to Calculate Location-Based Guidelines

1. **Determine the amount of electricity purchased:** The total electricity purchased and consumed during the reporting period in energy units, MWh or kWh, provide the most precise activity data. For guidance on how to interpret utility bills, see Chapter 7 of the EDF Climate Corps Handbook.
2. **Select emission factors:** Companies that purchase electricity from the electric grid should use regional or sub-regional emission factors provided by the EPA's Emissions and Generation Resource Integrated Database, eGRID. Electricity is generated in varying ways across the U.S. and eGRID emission factors help capture the GHG emissions associated with the forms of energy generation unique to the facilities' region. The EPA's eGRID sub-region map can be used to determine the appropriate sub-region for each facility.
3. **Quantify emissions:** The EPA Simplified GHG Emissions Calculator, which uses 2018 emission factors from eGRID. Companies calculate emissions by inputting the amount of electricity purchased and selecting the eGRID sub-region in which the processing facility is located.

(Figure 18) Steps to calculate location-based guidelines

Works Cited

1. Environmental Protection Agency. 2016. Indirect Emissions from Purchased Electricity Guidance. Center for Corporate Climate Leadership. http://bit.ly/2HUTgCz
2. World Resources Institute. 2015. GHG Protocol Scope 2 Guidance. An Amendment to The GHG Protocol Corporate Accounting and Reporting Standard. http://bit.ly/2jzMLpZ
3. The Climate Registry General Reporting Protocol, Version 3.0. 2019. Pages C-9 - C-16. Emissions to Include in the Inventory. https://bit.ly/3B4xPM7
4. The GHG Protocol Corporate Accounting and Reporting Standard. World Resources Institute, World Business Council for Sustainable Development, 2015: http://bit.ly/2yhHn0z

Additional Resources

- EDF Climate Corps Handbook, Chapter 7. Benchmarking energy usage and interpreting utility bills.
- EDF Climate Corps Handbook, Chapter 16. Demand response and smart grid.

Measurement and Estimation Uncertainty of GHG Emissions

Chapter at a Glance

- Emissions Uncertainty
- Calculating Uncertainty

GHG emissions uncertainty is dependent upon the quality of data collected and methods used to calculate emissions. Several types of uncertainties associated with GHG inventories range from natural variations, such as human error, to statistical uncertainty related to the indirect measurement of emissions (e.g., activity data and an emission factor). A well-designed IMP that follows the quality and documentation guidelines outlined in each section of this document can help reduce uncertainty.

Guidance on Uncertainty Assessment

The GHG Protocol Guidance on Uncertainty Assessment in GHG Inventories and Calculating Statistical Parameter Uncertainty describes the functionality of the tool and provides users with information on how to prepare, interpret and utilize inventory uncertainty assessments. The guidance is based on the IPCC Guidelines for National GHG Inventories.

Uncertainty Assessment Calculator

The GHG Protocol Cross Sector Calculation Tool, Measurement and Estimation Uncertainty of GHG Emissions is applicable to many industries and businesses regardless of sector. The calculation tool aggregates parameter uncertainties across source categories and the entire inventory.

Works Cited

1. World Resources Institute. 2003. GHG Protocol guidance on uncertainty assessment in GHG inventories and calculating statistical parameter uncertainty: http://bit.ly/2KFbCVO

Additional Resources

- The GHG Protocol Cross Sector Calculation Tool, Measurement and Estimation Uncertainty of GHG Emissions: http://bit.ly/2Pp8oKU
- The GHG Protocol Guidance on Uncertainty Assessment in GHG Inventories and Calculating Statistical Parameter Uncertainty. Guidance on how to use the Measurement and Estimation Uncertainty of GHG Emissions calculation tool: http://bit.ly/2KFbCVO
- The GHG Protocol Corporate Accounting and Reporting Standard, Chapter 7, Managing Inventory Quality: http://bit.ly/2yhHn0z

Target Setting

Chapter at a Glance

- Target Setting
- Science-Based Targets
- Target Setting Resources

GHG emissions reduction target setting and mitigation strategies have become a priority issue across company supply chains. The increasing number of public GHG emission reduction commitments are strategic decisions grounded in opportunities to capture business value and reduce company risk.

Companies can set two broad types of GHG reduction target metrics — an absolute emissions target or an intensity emissions target. Intensity targets specify emissions reductions relative to productivity or economic output, such as tons of CO_2e/lbs. of product produced. Both intensity and absolute targets specify a reduction in emissions relative to a historical baseline year. They ensure that emissions reductions are maintained with company growth. Companies should carefully evaluate both types before choosing a target metric and consider seeking outside support to determine the target type and actual target. Several organizations can assist in establishing targets:

- WWF Climate Savers
- Climate Registry
- Pew Business Environmental Leadership Council
- Carbon Trust

Once an emissions target is defined, it is crucial to consistently track performance over time. Specifically, a company may be required to recalculate its baseline year inventory whenever the following happens:

- Significant changes in the structure of the reporting company
- Significant changes in the calculation methodology
  - Improved emission factors
  - Improved activity data
- Discovery of significant errors or smaller errors that are collectively significant

The GHG Protocol Corporate Standard does not have a set definition for "significant," however, a company should determine its own significance threshold (i.e., 2 percent) to define when changes, in aggregate, should trigger recalculation of the baseline year inventory.

Structural changes are defined as the transfer of ownership or control of emitting activities from one company to another. They can occur via:

- Mergers, acquisitions and divestments
- Outsourcing or in-sourcing of emitting activities

For more information on emissions tracking over time, companies may reference the GHG Protocol Corporate Standard.

NOTE: Recalculation is not needed if out- or in-sourced activities were previously included in a different scope.

Science-Based Targets

The Science-Based Target Initiative is a collaboration between the CDP, UN Global Compact, World Resources Institute and World Wildlife Fund to assist corporations in establishing GHG targets that are in line with climate science. The initiative defines Science-Based Targets as: "Targets in line with the level of decarbonization required to keep global temperature increase below 1.5 degrees C compared to pre-industrial temperatures, as described in the Assessment Report of the Intergovernmental Panel on Climate Change (IPCC)."

Aligning targets with climate science is becoming the business norm. It is widely accepted that global action must be taken to avoid some of the most disastrous and irreversible impacts of climate change. The following resources provide the causes and predicted impacts of climate change:

- NASA Global Climate Change[2]
- NOAA National Centers for Environmental Information[3]
- The Global Carbon Project[4]
- The visualization of temperature change from 1880 to 2016 as analyzed by NASA's Goddard Institute for Space Studies.

GHG Inventory Guidance

By adopting Science-Based Targets, dairy processing companies take a leadership role in addressing climate change by connecting corporate sustainability goals to scientifically established thresholds. Case studies featuring companies with Science-Based Targets demonstrate the benefits and reasons for setting reduction goals that are in line with climate science.

Examples of benefits derived from Science-Based Targets are:

- Cut costs and reduce risk: Companies with ambitious targets can ensure durability and efficiency in a future where fossil fuels are increasingly more expensive.
- Build credibility and reputation: Sustainability has become a lens through which a company is evaluated. Taking leadership action on climate change can build a company's reputation among key stakeholders.
- Drive innovation: Adopting Science-Based Targets can drive company and industry-wide innovation and help to turn climate risk into a business opportunity.

Works Cited

1. Citation: World Economic Forum, The Global Risks Report, 2017. http://bit.ly/2roi5LW
2. NASA Global Climate Change: https://climate.nasa.gov/
3. NOAA National Centers for Environmental Information: https://www.ngdc.noaa.gov
4. The Global Carbon Project: http://www.globalcarbonproject.org/

Additional Resources

- WWF Climate Savers: https://climatesavers.org/
- Climate Registry: https://www.theclimateregistry.org/
- Pew Business Environmental Leadership Council: https://www.c2es.org/our-work/belc/
- Carbon Trust: https://www.carbontrust.com/home/
- NASA's Goddard Institute for Space Studies: https://svs.gsfc.nasa.gov/4546
- Carbon Budget: http://bit.ly/2WifVwi
- 2024 Carbon Budget Report: https://essd.copernicus.org/preprints/essd-2024-519/
- The U.S. Department of Energy Map: http://bit.ly/2rpEt8p
- The Impact of Corporate Sustainability on Organizational Process and Performance: The Harvard Business Journal, Robert G. Eccles, Ioannis Ioannou & George Serafeim, https://bit.ly/4gmKUz6

Resources for Setting Science-Based Targets

- Introduction to Science-Based Targets: http://bit.ly/2rpLt4m
- Call to Action: Detailed Guidelines for Setting Science-Based Targets, https://bit.ly/33Okx0o
- Science-Based Targets and CDP Scoring: http://bit.ly/2KFhnmg
- Science Based Targets Forests, Land and Agriculture: https://sciencebasedtargets.org/sectors/forest-land-and-agriculture
- Best Practices for Setting and Achieving Science-Based Targets: Presentation at the Climate Leaders Conference, March 2017. http://bit.ly/2jBMuTF
- Science-Based Targets: Target setting pitfalls and lessons learned (pdf), http://bit.ly/2FPus8Q
- Science-Based Targets: Target setting pitfalls and lessons learned (webinar), https://vimeo.com/233570395

Resources for Reducing GHG Emissions

Once a GHG emissions inventory has been developed and a reduction target has been adopted, a company should identify the main sources of GHGs and evaluate the cost-effectiveness of emission reduction measures. Below are resources, tools and webinars to assist companies in reducing GHG emissions.

Additional Resources

Energy Efficiency

- EPA, Energy Star. 2011. Energy Efficiency Improvement and Cost Saving Opportunities for the Dairy Processing Industry: A manual created by Energy Star to assist dairy processors in identifying energy efficiency improvements as an important way to reduce costs and increase predictable earnings: http://bit.ly/345L8Wi
- EPA, Energy Star Portfolio Manager. An online tool that can be used to measure and track energy and water consumption, as well as greenhouse gas emissions associated with commercial buildings: http://bit.ly/2FP3Epu
- HVAC (heating, ventilation and air conditioning), Climate Corps Handbook Chapter 9. Overview of how to survey current HVAC system, analyze results of an energy audit for HVAC system and perform a financial analysis on recommendations of energy auditors: http://bit.ly/2rod1qI
- Carbon Trust: Heating, ventilation and air conditioning (HVAC) energy efficiency guide. A guide to improve energy efficiency of heating, ventilation and air conditioning, hot water and boilers: http://bit.ly/2jAHmiE
- Lighting in commercial buildings, Climate Corps Handbook, Chapter 10. Describes how to identify lighting opportunities for energy savings in commercial buildings and how to develop estimates of energy usage and calculate the estimated savings potential: http://bit.ly/2rod1qI
- Demand Response and Smart Grid, Climate Corps Handbook, Chapter 16. Overview of demand response (DR) and possible energy savings and revenue opportunities: http://bit.ly/2rod1qI
- Demand and Response Research Center. Publications and information on demand response and smart grid infrastructure to best inform end users how to temporarily reduce energy usage in response to either price or system reliability triggers: https://drrc.lbl.gov
- Carbon Trust Energy Management Self-Assessment Tool. An Excel workbook and guidance document that assesses an organization's energy management: http://bit.ly/2whnWrY
- Carbon Value Analysis Tool. The Carbon Value Analysis Tool (CVAT) was created by the World Resources Institute to assist project managers with factoring the price of carbon when evaluating reduction projects: http://bit.ly/2jB0pt6
- Carbon Trust, Building Energy Efficiency. Guide to improving building fabric and insulation and installing appropriate controls to save money and cut carbon emissions: http://bit.ly/2rmNI9C
- Carbon Trust, Refrigeration: Improve energy efficiency of your chillers and refrigeration systems with our energy-saving guidance: http://bit.ly/2JUV62Q
- EPA Center for Corporate Climate Leadership. A list of free GHG inventory-related webinars and events: http://bit.ly/2FOcALR

Renewable Energy:

- The Department of Energy's Office of Energy Efficiency and Renewable Energy (EERE). Provides information on industrial energy-consuming systems; boiler and steam systems, compressed air, motors, fans, pumps and process heating: http://bit.ly/2K0x0nb
- Property Assessed Clean Energy (PACE). Energy efficiency financing opportunities: http://bit.ly/2FPWGjX
- Database of State Incentives for Renewables and Efficiency. Overview of state and federal incentives and policies designed to help companies adopt renewable energy programs: http://www.dsireusa.org

continued on next page

Resources for Reducing GHG Emissions

Additional Resources

- Guide to Purchasing Green Power. A cooperative effort between the EPA, the U.S. Department of Energy, the World Resources Institute and the Center for Resource Solutions that provides current and potential buyers of green power with information about green power purchasing: http://bit.ly/2JU8WlK
- Innovations in Voluntary Renewable Energy Procurement. A guide from the National Renewable Energy Laboratory (NREL) that outlines methods for expanding access and lowering costs for communities, governments and businesses: https://www.nrel.gov/docs/fy12osti/54991.pdf

Mobile Emissions

- Reduce Mobile Emissions, Vehicle selection. ACEEE Greener Cars Identify vehicles that are most fuel-efficient and learn about market trends in automotive technology: https://greenercars.org/
- EPA Green Vehicle Guide. Overview of vehicles, fuel use and the impact on both the environment and bottom line: https://www.epa.gov/greenvehicles
- Fuel Economy Guide, The U.S. Environmental Protection Agency (EPA) and U.S. Department of Energy (DOE). A guide to help buyers identify the most fuel-efficient vehicles: https://www.epa.gov/fueleconomy

About the Innovation Center for U.S. Dairy®

The Innovation Center for U.S. Dairy® is a forum that brings together the dairy community to address the changing needs and expectations of consumers through a framework of shared best practices and accountability. Initiated in 2008 by dairy farmers through the dairy checkoff, we collaborate on efforts that are important both to us and our valued customers — in areas like animal care, food safety, nutrition and health, the environment and community contributions.

Visit USDairy.com for more information about the Innovation Center for U.S. Dairy.

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