California Climate Action Registry
General Reporting Protocol

October 2002

California Climate Action Registry
515 S. Flower Street, Suite 1305
Los Angeles, CA 90071

Reporting Assistance Hotline:
1-877-CO2-CCAR
(1-877-262-2227)

Email:
help@climateregistry.org

Website:
http://www.climateregistry.org

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U.S. Environmental Protection Agency

U.S. EPA Climate Leaders

World Business Council for Sustainable Development

World Resources Institute

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Abbreviations and Acronyms

Btu	British Thermal Unit(s)
CARB	California Air Resources Board
CARROT	Climate Action Registry Reporting Online Tool
CEC	California Energy Commission
CEMS	Continuous Emissions Monitoring Systems
CHP	combined heat and power
CH_4	methane
COP	coefficient of performance
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
EIA	U.S. Energy Information Administration
EIIP	Emissions Inventory Improvement Program
EPA	U.S. Environmental Protection Agency
g	gram(s)
GCV	gross caloric value
GHG	greenhouse gas
GWP	global warming potential
ha	hectare(s)
HDV	heavy duty vehicle
HFC	hydrofluorocarbon
HHV	higher heating value
IPCC	Intergovernmental Panel on Climate Change
IPP	independent power producer
kg	kilogram(s)
kWh	kilowatt-hour(s)
lb	pound
LDT	light duty truck

LHV	lower heating value
LPG	liquefied petroleum gas
Mcf	thousand cubic feet
mi	mile(s)
MMBtu	one million British Thermal Units
MWh	megawatt-hour(s)
NCV	net caloric value
NO_x	oxides of nitrogen
N_2O	nitrous oxide
PFC	perfluorocarbon
RFA	Request for Applications
SAR	IPCC Second Assessment Report (1996)
SB 1771	California Senate Bill 1771 (passed August 31, 2000)
SB 527	California Senate Bill 527 (passed September 14, 2001)
SF_6	sulfur hexafluoride
T&D	transmission and distribution
UNFCCC	United Nations Framework Convention on Climate Change
WBCSD	World Business Council for Sustainable Development
WRI	World Resources Institute

Key Terms

Baseline	Datum against which to measure GHG emissions performance over time, usually annual emissions in a selected base year.
Batch Certification	Simultaneous certification process arranged by the Registry for multiple participants with simple GHG emissions (typically only indirect emissions from electricity consumption and direct emissions from stationary combustion at a single site and/or direct emissions from five or less vehicles).
CO_2-equivalent*	(CO_2e) The quantity of a given GHG multiplied by its total global warming potential. This is the standard unit for comparing the degree of harm which can be caused by different GHGs.
Certification	The process used to ensure that a given participant's greenhouse gas emissions inventory (either the baseline or annual result) has met a minimum quality standard and complied with the Registry's procedures and protocols for calculating and reporting GHG emissions.
Datum	A reference or starting point.
De Minimis	A quantity of GHG emissions from one or more sources, for one or more gases, which, when summed equal less than 5% of an organization's total emissions.
Direct Emissions	Emissions from sources that are owned or controlled by the reporting organization.
Emission Factor*	A factor relating activity data and absolute GHG emissions.
Equity Share	Fractional percentage or share of an interest in an entity based either on ownership interest, or on some other contractual basis negotiated among the entity's stakeholders.
Fugitive Emissions*	Intentional and unintentional releases of GHGs from joints, seals, gaskets, etc.
Global Warming Potential*	(GWP) The ratio of radiative forcing (degree of harm to the atmosphere) that would result from the emission of one unit of a given GHG to one unit of CO_2.
Greenhouse Gases	(GHG) For the purposes of the Registry, GHGs are the six gases identified in the Kyoto Protocol: Carbon Dioxide (CO_2), Nitrous Oxide (N_20), Methane (CH_4), Hydrofluorocarbons (HFCs), Perfluorocarbons (PFCs), and Sulphur Hexafluoride (SF_6).
Indirect Emissions	Emissions that are a consequence of the actions of a reporting entity, but are produced by sources owned or controlled by another entity.
Management Control	The ability of an entity to govern the operating policies of another entity or facility so as to obtain benefits from its activities.

Material	Any emission of GHG that is not de minimis in quantity.
Mobile Combustion*	Burning of fuels by transportation devices such as cars, trucks, airplanes, vessels, etc.
Member	An entity that is preparing its annual GHG Emission Report, but has not yet submitted its certified report to the Registry.
Outsourcing*	The contracting out of activities to other businesses.
Process Emissions*	Emissions generated from manufacturing processes, such as cement or ammonia production.
Stationary Combustion*	Burning of fuels to generate electricity, steam, or heat.

*Definitions of key terms obtained from "The Greenhouse Gas Protocol, A Corporate Accounting and Reporting Standard," World Business Council for Sustainable Development and World Resources Institute, Switzerland, September 2001.

Part I Introduction

Overview

This General Reporting Protocol (the Protocol) provides the framework for businesses, government agencies, and non-profit organizations to participate in the California Climate Action Registry (the Registry), a voluntary greenhouse gas (GHG) registry.

The Protocol provides the principles, approach, methodology, and procedures required for effective participation in the Registry. It is designed to support the complete, transparent, and accurate reporting of an organization's GHG emissions in a fashion that minimizes the reporting burden and maximizes the benefits. The Protocol guides participants through the reporting rules, emission calculation methodologies, and the Registry's standardized reporting via its web-based reporting system, the Climate Action Registry Reporting Online Tool (CARROT).

Reporting GHG Emissions

Registry participants will voluntarily submit their GHG emissions to the Registry each year. At a minimum, participants will report their material entity-wide emissions of the Kyoto GHGs (CO_2, CH_4, N_2O, HFC, PFC, SF_6) for each of the following applicable emission source categories:

- Indirect emissions from electricity, heat, or steam usage
- Direct emissions mobile source combustion
- Direct emissions from stationary combustion
- Direct process emissions
- Direct fugitive emissions

Participants submit Annual GHG Emission Reports (Emission Reports) via the Registry's online calculation and reporting tool---CARROT. Each Annual GHG Emission Report will contain at least the following information:

- The geographic scope of the Emission Report (whether California-only or nationwide);
- The "boundaries" of the reporting entity for which GHG emission data is reported;
- A GHG emissions baseline, if any, to assess changes in total emissions from year to year;
- Total material direct GHG emissions (from mobile combustion, stationary combustion, industrial process emissions, and fugitive emissions); and
- Total material indirect GHG emissions (from electricity usage, and from co-generation, steam imports, or district heating or cooling).

Before Emission Reports will be accepted by the Registry, they must be certified by an "approved certifier." Approved certifiers are screened and approved by the California Energy Commission (CEC) and the Registry to ensure that they have the necessary skills to appropriately evaluate Emission Reports.

This Protocol is intended to be used in combination with the Registry's Certification Protocol and web-based calculation and reporting tools.

Background on the California Climate Action Registry

The Registry is a non-profit, public benefit corporation that accepts standardized GHG Emission Reports for organizations with California and/or U.S. emissions. Following considerable initiative and input from various stakeholders from the business, government, and the environmental communities, the California State Legislature established the Registry in 2000, with technical modifications in 2001.[1]

To see the enabling legislation, please see **www.climateregistry.org** under About Us

The purposes of the Registry are as follows:

- To help various entities to establish emissions baselines that may be applied against any future federal GHG emissions reduction requirements;
- To encourage voluntary actions to increase energy efficiency and reduce GHG emissions;
- To enable participating entities to voluntarily record GHG emissions made after 1990 in a consistent format that is certified;
- To ensure that participating organizations receive appropriate consideration for certified emissions results under any future state, federal or international regulatory regime relating to GHG emissions;
- To recognize, publicize, and promote participants in the Registry; and
- To recruit broad participation in the process.

In June 2002, the Registry's Board of Directors received the *Guidance to the California Climate Action Registry: General Reporting Protocol*, from the CEC.[2] The Registry's Board of Directors instructed that this Protocol reflect much of the policy guidance provided.

A complete version of the CEC Guidance is available at **www.climateregistry.org**

Both the CEC Guidance and Registry Protocol draw heavily from the World Resources Institute/World Business Council for Sustainable Development's (WRI/WBCSD) "Greenhouse Gas Protocol: A corporate accounting and reporting standard," a multi-stakeholder effort to develop a standardized approach to the voluntary reporting of GHG emissions.[3]

How the Protocol is Organized

The Protocol is divided into four Parts, which contain thirteen Chapters. Each Chapter provides guidance on the specific steps participants will need to take to complete and submit

[1] California Senate Bill 1771 was approved by the Governor on September 30, 2000. Senate Bill 527 was signed into law on October 13, 2001. See Cal. Health & Safety Code §§42800 *et seq*.

[2] California Energy Commission, *Committee Report: Guidance to the California Climate Action Registry: General Reporting Protocol*, P500-02-005F (June 2002).

[3] World Resources Institute/World Business Council on Sustainable Development, *The Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard* (2001). For more information, see **www.ghgprotocol.org**.

their GHG Emission Report to the Registry. Depending upon the complexity and the nature of reported GHG emissions, some of the steps in this Protocol may not apply to all

organizations. Nevertheless, the Registry encourages participants to review the document as a whole to ensure that they have identified all reporting requirements.

Part I: Introduction

Contains:

- An overview of the General Reporting Protocol and the reporting process
- A brief background on the genesis and objectives of the Registry
- A description of participant categories used as examples in this Protocol
- A Road Map for navigating and using this Protocol
- An introduction to online reporting
- A list of technical help resources
- Answers to key questions about using the Protocol

Part II: What You Should Report (Chapters 1-4)

Provides guidance on:

- Determining geographic boundaries of GHG emissions (i.e., California or the entire U.S.)
- Determining organizational boundaries of GHG emissions
- Setting an emission baseline
- Determining operational boundaries of GHG emissions

Part III: Quantifying Your Emissions (Chapters 5-10)

Provides direction on calculating:

- Indirect emissions from electricity
- Direct emissions from mobile combustion
- Direct emissions from stationary combustion
- Indirect emissions from co-Generation, imported steam, and direct heating or cooling
- Direct process emissions
- Direct fugitive emissions

Part IV: Completing and Submitting Your Report (Chapters 11-13)

Describes how to finalize Emission Reports by:

- Determining de minimis emissions
- Explaining how to prepare and submit an annual Emission Report using the CARROT
- Providing an overview of the certification process

The Registration Process from Start to Finish

The following fifteen steps take you through the complete registration process—from your initial contact and setup with the Registry, to preparing your annual Emission Report, obtaining certification and, submitting your certified Emission Report to the Registry.

❑ Step 1: Contact the Registry to discuss participation

Contact the Registry
1-213-891-1444

Contact the Registry by phone (213-891-1444) or email (**info@climateregistry.org**) to discuss reporting your annual GHG emissions.

❑ Step 2: Sign the Letter of Intent and pay your annual membership fee

Membership Information
www.climateregistry.org

See the Registry's website (**www.climateregistry.org**) for an electronic version of the Letter of Intent and additional information about annual membership fees.

❑ Step 3: Receive a Username and Password to access the CARROT through the Internet.

CARROT Website
www.climateregistry.org

The Registry will provide you with a unique username and password which will allow you to create a protected account on the CARROT system, located at **www.climateregistry.org**.

❑ Step 4: Complete your GHG emissions report via the CARROT

You may complete your GHG Emission Report by either using the CARROT calculation tools, or by inputting your pre-calculated GHG emissions into the CARROT.

❑ Step 5: Review your GHG emissions report.

You should review and confirm that your GHG Emission Reports are complete and accurate. Once you feel confident about your Emission Report, you should classify your report as "Certification Ready" via CARROT.

❑ Step 6: Assemble relevant certification information.

You should print the "Certification Checklist" from CARROT, and begin to assemble the information you will be required to provide to your certifier.

❑ Step 7: Select an Approved Certifier to certify your emissions.

Depending on the size and complexity of your operations, you may wish to seek certification bids from a number of Registry-approved certifiers.

❑ Step 8: Negotiate a contract for certification services with an Approved Certifier.

See Chapter 13
Contracting with Your Certifier

❑ Step 10: Attend a certification kick-off meeting with your certifier.

This meeting will give certifiers an opportunity to discuss the number and complexity of your emissions sources, your Emission Report, your quantification methodologies, and overall certification activities.

❑ Step 11: Enable your certifier to conduct the certification activities

If you have not already done so, provide your certifier with "read only" access to your reported emissions and relevant emissions information. Chapter 13 provides a detailed list of recommended documents that you should supply to your certifier.

❑ Step 12: Review your Certification Report and Certification Opinion

You should carefully review their Certification Report and Certification Opinion to ensure that you understand your certifier's assessment of your GHG Emission Report.

❑ Step 13 Attend an exit meeting with your certifier.

Certifiers should summarize their evaluation of your GHG Emission Report in a meeting where certifiers can answer any questions you have regarding the certification activities. At this point, you can authorize your certifier to submit your Emission Report to the Registry.

❑ Step 14: Certifier competes online certification form and submit the authorized Certification Opinion to the Registry.

Certifiers will complete the certification form in the CARROT system and classify your reported emissions as "Certified."

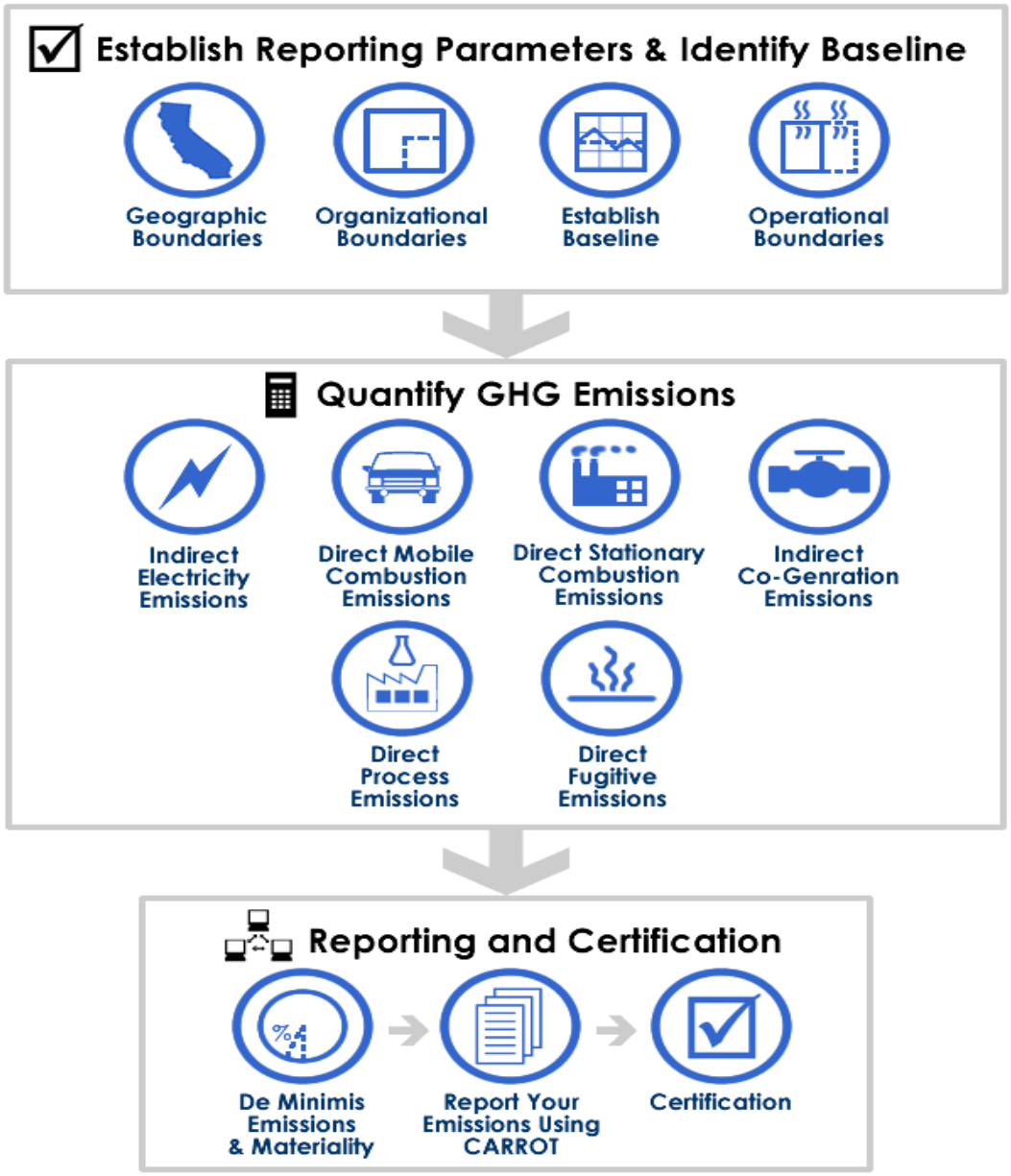
❑ Step 15: The Registry will review the Certification Opinion and "accept" your data into the Registry's database.

At this point, your entity-level emissions information will be available to the public via a public-only data report in the CARROT (www.climateregistry.org).

GHG Emissions Reporting Process

The flow chart below illustrates the GHG emission reporting process from start to finish. The orientation symbols shown here are also used at the beginning of each chapter to use as guideposts throughout the Protocol.

Figure I-1. The GHG Emissions Reporting Process Used in this Protocol



Navigating The Protocol

Depending on the size and complexity of your organization, you may be required to calculate a variety of GHG emissions. To simplify the process of navigating this document, the Protocol uses four categories (A, B, C, and D) to describe generic characteristics of organizations that will have different reporting needs. The different participant categories will have different requirements for registration depending on their business circumstances, their emissions types, individual preferences, and other factors.

These categories should help you better understand which chapters will be most important for you to review, and which may not apply. The categories are meant to be illustrative—your organization may have a combination of categories or a mix of elements of each.

Ⓐ **Category A** includes organizations that have only indirect GHG emissions from electricity and/or direct GHG emissions from mobile combustion.

Ⓑ **Category B** includes all Category A emissions, as well as direct emissions from stationary combustion.

Ⓒ **Category C** includes all Category A and B emissions, as well as indirect emissions from co-generation, imported steam, or district heating or cooling.

Ⓓ **Category D** includes all Category A, B, and C emissions, as well as direct GHG emissions from manufacturing processes and/or fugitive emissions.

These categories are used in the instructions, explanations, and examples provided throughout the Protocol to help simplify your reporting process. Look for the category icon that best matches your organization's operations throughout the Protocol, and use the Road Map below to get a better sense of the specific sections of the Protocol you will need to review to compile your GHG Emission Report.

Road Map

Only rarely will participants need to use all of the elements of this Protocol. In most cases, you will not need to read and implement every element of the Protocol. Guidance is provided in the Road Map and Flow Chart and at the beginning of each chapter to help you identify which chapters you will need to review.

Consider each step in the road map in order to determine which chapters will pertain to your emissions.

❑ Step 1: Determine Geographic Boundaries (Chapter 1)

Participant Category

Organizations with Facilities Both Inside and Outside of California

You should review the discussion on Geographic Boundaries in Chapter 1 and understand the options for reporting emissions both for California and for the entire United States, or for California only.

Continue to Step 2

Ⓐ Ⓑ Ⓒ Ⓓ

You will need to review **Chapter 1**

Organizations with Facilities in California Only

You do not need to review Chapter 1, Geographic Boundaries.

Continue to Step 2

Ⓐ Ⓑ Ⓒ Ⓓ

You may skip Chapter 1

Organizations with No Facilities in California

You should review the discussion on Geographic Boundaries and understand the requirements involved in reporting emissions only outside of California.

Continue to Step 2

Ⓐ Ⓑ Ⓒ Ⓓ

You will need to review **Chapter 1**

❑ Step 2: Determine Organizational Boundaries (Chapter 2)

Organizations that wholly own and operate all of their facilities.

You do not need to review the discussion on Organizational Boundaries.

Continue to Step 3

Ⓐ Ⓑ Ⓒ Ⓓ

You may skip Chapter 2

Organizations with Partial Ownership of or Management Control over Other Organizations (Subsidiaries, Joint Ventures, Partnerships, etc.)

You should review the discussion on Organizational Boundaries in Chapter 2 and understand the options for reporting emissions on behalf of or in coordination with other organizations with which yours is affiliated.

Continue to Step 3

Ⓐ Ⓑ Ⓒ Ⓓ

You will need to review **Chapter 2**

❑ Step 3: Establish and/or Update Your Baseline (Chapter 3)

Participant Category

All participants should consider establishing an emissions baseline.

All participants should complete Chapter 3 on establishing a baseline. If you have completed your first year of reporting and wish to update your baseline, review the requirements in Chapter 3.

All Participants will need to review **Chapter 3**

Continue to Step 4

❑ Step 4: Establish Operational Boundaries (Chapter 4)

All Participants

You will need to consider what kinds of direct and indirect emissions your organization produces in order to assess which sections to complete in Part III, Chapters 5-10.

You should review **Chapter 4**

Continue to Step 5

❑ Step 5: Quantify Your Emissions (Chapters 5-10)

Organizations that Generate…

○ Indirect GHG Emissions from Electricity (Chapter 5)

Those organizations consuming electricity from a public utility or another source outside its organizational boundaries (i.e., the organization does not produce its own electricity) will need to complete the requirements provided in Chapter 5.

You will need to review **Chapter 5**

Continue to Next Source

○ Direct Emissions from Mobile Sources (Chapter 6)

Those organizations that produce GHG emissions from motor vehicles owned and operated by the organization itself, employees, and others, will need to complete the requirements provided in Chapter 6.

You will need to review **Chapter 6**

Continue to Next Source

○ Direct Emissions from Stationary Combustion (Chapter 7)

Those organizations that produce GHG emissions from stationary combustion operations at facilities they own or control as defined in Step 2 will need to complete the requirements provided in Chapter 7.

You will need to review **Chapter7**

Continue to Next Source

Participant Category

Indirect Emissions from Co-Generation, Imported Steam, and District Heating or Cooling (Chapter 8)

Those organizations that produce GHG emissions from co-generation, imported steam, and district heating or cooling operations will need to review the requirements provided in Chapter 8.

Ⓒ Ⓓ

You will need to review **Chapter 8**

Continue to Next Source

Direct Emissions from Process Manufacturing (Chapter 9)

Those organizations that produce GHG emissions from process manufacturing will need to complete the requirements provided in Chapter 9.

Ⓓ

You will need to review **Chapter 9**

Continue to Next Source

Direct Fugitive Emissions (Chapter 10)

Those organizations that produce fugitive emissions from manufacturing, natural gas transport and distribution, coal mining, waste management, wastewater treatment, and refrigerant leakage from air conditioning and refrigeration equipment will need to complete the requirements in Chapter 10. ***Note, any Category A, B, and C organizations with material fugitive emissions, including refrigerant leakage from air conditioning, should complete Chapter 10.*** *Step 1 in Chapter 10 provides information on determining whether your fugitive emissions from refrigerant leakage are de minimis.*

Ⓓ

You will need to review **Chapter 10**

Continue to Step 6

❑ Step 6: Determine De Minimis Levels and Materiality (Chapter 11)

Organizations with Only One Facility and Relatively Simple Operations

If your organization has only one facility, such as a small office or a single building, and no other facilities, it may be unnecessary to determine de minimis levels. Quickly review Chapter 11 to determine whether it is necessary to complete the de minimis analysis.

Ⓐ

You **may** need to review **Chapter 11**

Continue to Step 7

Organizations with More that One Facility or More Complex Operations

In order to determine the degree of emissions quantification that will be needed to complete the GHG Emission Report, review and complete the de minimis requirements and threshold for your organization in Chapter 11.

Ⓑ Ⓒ Ⓓ

You will need to review **Chapter 11**

Continue to Step 7

❑ Step 7: Complete and Certify your Annual GHG Emission Report (Chapters 12-13)

All participants

Chapters 12 and 13 will provide you with the necessary tools and understanding of the reporting and certification processes.

All participants will need to review **Chapters 12 and 13**

Web-Based Reporting and Technical Assistance

The CARROT (Climate Action Registry Reporting Online Tool)

Submitting your annual GHG Emission Report to the Registry is designed to be as simple and straightforward as possible. The Registry has developed a web-based reporting application—the CARROT (Climate Action Registry Reporting Online Tool)--modeled after this Protocol to enable you to submit your Emission Report online.

The CARROT serves two purposes. It is both an emissions calculation tool as well as the Registry's emissions reporting forms, and is located on the Registry's website (**www.climateregistry.org**). All emissions reporting will be performed via the CARROT---the Registry will not accept hard-copy Emission Reports. The website provides you with a variety of technical resources for getting started, context-based Help links, Frequently Asked Questions, and other supporting information including an electronic version of this Protocol. There is also a brief Getting Started Guide that orients new users to the CARROT.

A short demonstration of the CARROT application can be found on the home page of the Registry's website (**www.climateregistry.org**).

Registry Technical Assistance:
1-877-CO2-CCAR

CARROT Application and Demonstration:
www.climateregistry.org

CARROT Help:
help@climateregistry.org

Technical Assistance

The Registry has designed a number of ways to help you as you proceed through the emissions reporting process. If you have a question or problem as you are completing your Emission Report, you may contact the Registry technical staff in the following ways:

Registry Technical Assistance Hotline (members only please)

Call: 1-877-CO2-CCAR

Registry Technical Email Address

Email: help@climateregistry.org

Make an appointment to meet with Registry Technical Staff

Call 213-891-1444 to make an appointment

The Registry's technical staff is happy to provide timely and useful answers to members' questions.

Additionally, the CARROT contains online help features that should answer most of your application questions. Frequently Asked Questions are posted on the Registry's website

(**www.climateregistry.org**), and Key Questions are highlighted in both the General Reporting and the Certification Protocols.

"How-To" Workshops

Beginning in the winter of 2002, the Registry will facilitate regular "How-To" workshops across the state of California to help participants understand how to use the General Reporting Protocol and the CARROT application. These workshops include specific guidance on calculating and certifying GHG emissions. All interested parties are invited to participate. Please contact the Registry for more details (213-891-1444) and see the website for a calendar of upcoming workshops (**www.climateregistry.org**).

Registry Technical Assistance:
1-877-CO2-CCAR

Registry Website:
www.climateregistry.org

CARROT Help:
help@climateregistry.org

Key Questions

Below are clarifications on some basic issues that should assist you as you begin to prepare your GHG Emission Report. If you have a question that is not answered in this Protocol, please contact the Registry at **help@climateregistry.org**. If you have a question that requires immediate assistance, please contact our help line at **1-877-CO2-CCAR**.

Membership and Fees: *How do I join the Registry? What does it cost?*

If you are interested in joining the Registry, please call the Registry's main office at 213-891-1444 or visit the website (www.climateregistry.org) for more information and instructions on getting started.

Membership fees are tiered based on the size of your organization, and are not expected to discourage anyone from participation. Specific information is available on the Registry website at **www.climateregistry.org** under Registry Program/Fee Structure.

Member Benefits: *What are some of the advantages of joining the Registry?*

Joining the Registry provides several important benefits to participants. For example, participating in the Registry helps participants address inefficiency. Understanding that emissions indicate waste and inefficiency has led many companies to insights for redesigning business operations and processes, spurring innovation, improving products and services, and helping to build competitive advantage. Similarly, taking steps to protect your early actions ahead of possible future GHG regulations is a wise risk-management strategy. Without a credible and transparent measurement, verification and reporting system, emission trading cannot work. In addition, early movers on addressing climate change are in the best position to help influence future policy, and to understand the most cost-effective means of managing and reducing emissions.

Emissions Trading: *Can I use my Registry GHG Emission Report to trade GHG emissions?*

While the Registry itself does not serve as a brokerage house for GHG emissions trading, the reporting and certification processes adopted by Registry participants will promote credibility, transparency, and accuracy in private or government-sponsored trading programs today or in the future.

Eligibility to Report: *Who may report their GHG emissions?*

Any entity that conducts business activities in the State of California—such as a corporation or other legally constituted body, a non-profit organization, any city or county, and each State government agency—may report. If your organization does not have operations or emissions

in California, then you may report your total U.S. emissions, and indicate that your California emissions are zero. Organizations with operations in multiple states may NOT register a single state's emissions (except California emissions)--partial nation-wide reporting is not permitted. To reiterate, any organization can participate if they can report either their total California emissions, or their total U.S. emissions.

Adhering to the Protocol guidelines: *Must a company or organization follow this Protocol to participate in the Registry?*

Participants in the Registry are expected to make every effort to report in a manner consistent with this Protocol. However, the Registry recognizes that participants may be faced with unique situations that are not addressed in the Protocol or in some cases the implementation of the protocol would create undue burden. In such circumstances the Registry welcomes suggested revisions to the Protocol.

All comments about the Protocol should be submitted to the Registry using the Protocol Comment Form, which is available on the website (**www.climateregstry.org**). Suggestions should clearly document an alternative approach and the manner in which the alternative approach would continue to meet the general intent and purpose of the Protocol. Suggested revisions will be submitted to the Registry board for review at each of the Board's meetings. Changes to the Protocol will be approved by the Board.

Geographic Boundaries: *Should I report all of my U.S. emissions or just California emissions?*

See Chapter 1
Geographic Boundaries

Participants are encouraged to report all U.S. emissions and must, at a minimum, report all California emissions. Participants reporting nationwide emissions will be required to simultaneously report California-only emissions. The Registry does not accept emissions released outside of the United States at this time. Participants can start with reporting California emissions and later move to U.S. reporting.

Level of Reporting: *Are participants permitted to report only individual facilities or projects?*

See Part II
What You Should Report

You are required to report, at a minimum, your entity-wide emissions in the state of California. However, the Registry encourages you to report at the facility level as part of your entity-wide GHG Emission Report. A partial report that includes only some but not all of your organization's facilities or operations, is not allowed. At this time, project level reporting is not permitted, however, the Registry is currently considering options to facilitate credible project level reporting. Please check the website (**www.climateregistry.org**) for the latest developments.

Materiality: *What GHGs do participants report?*

See Chapter 11
De Minimis Levels and Materiality

Each participant must evaluate what material emissions to include in the report, and what de minimis emissions can be left unreported. The Registry accepts GHG Emission Reports that include material emissions of the following six GHGs (Kyoto gases):

- Carbon Dioxide (CO_2)
- Methane (CH_4)
- Nitrous Oxide (N_2O)
- Hydrofluorocarbons (HFCs)
- Perfluorocarbons (PFCs)
- Sulfur Hexafluoride (SF_6)

Although participants are encouraged to report all six gases starting in year one, participants may opt to limit their reports to only carbon dioxide (CO_2) emissions during the first three years of participation in the Registry. After your third year of Registry participation, you will be required to include all six GHGs (if applicable) in your annual Emission Report.

Required Emission Reporting: *What types of emissions should I report?*

You should report all material direct and indirect emissions of the six Kyoto gases. *Direct emissions* are those emitted from sources owned or controlled by the reporting entity. For example, a cement manufacturer would report direct emissions resulting from the process of manufacturing cement. *Indirect emissions* are those that result from a participant's actions but are produced from sources owned or controlled by another entity. For example, a participant whose emissions result only from the consumption of electricity would calculate their indirect emissions from the amount of electricity they consume.

See Chapter 4
Operational Boundaries

What are de minimis emissions? *Do I have to calculate and report absolutely everything?*

De minimis emissions are emissions that are immaterial—they comprise less than 5% of your organization's total GHG emissions. While you are required to report at least 95% of your material emissions, you may choose not to report de minimis emissions, especially if it takes great effort to monitor, track and calculate these emissions. If you choose not to report your de minimis emissions, you must document the estimation/calculation that identifies the emissions as being less than 5% of your total emissions. Once de minimis emissions are approved by a certifier, they do not need to be calculated in the future (assuming that the quantity doesn't change). The Registry permits participants to not register their de minimis emissions in an effort to reduce reporting burdens, and concentrate efforts on material emissions.

See Chapter 11
De minimis Emissions

Emissions Baselines: *What is a baseline? What year can I use as the baseline? Will I be able to update my baseline?*

A baseline is a reference point (or datum) against which to measure GHG emissions increases or decreases over time. A baseline is determined by the initial reporting year, or any year 1990 or later for which you have sufficient data. Under this Protocol, participants are not required to establish a baseline reporting year at this time.

Should you choose to establish a baseline, your baseline should remain static over time, changing only to accommodate structural changes in your organization. Chapter 3 describes the approach used to update your baseline, if necessary.

See Chapter 3
Establishing and Updating Your Baseline

Reporting: *How do I report?*

After identifying your geographic, organizational, and operational boundaries, establishing your baseline, quantifying your emissions from each type of emissions source at the entity-level (and, preferably, at the facility level), and determining de minimis and material emissions you, will be ready to submit your GHG Emission Report to the Registry via the CARROT--located at **www.climateregistry.org**.

See Chapter 12
Reporting Your Emissions

Confidentiality: *Will the information I report be kept confidential?*

All aggregated entity-level emissions data and metrics reported to the Registry will be available to the public. However, the Registry intends to keep specific emissions (i.e., from the facility-, project-, or source-level), activity data, methodologies, and emissions factors confidential. Confidential information will only be accessible to the participant, the Registry,

and the participant's chosen certifier, unless the participant allows others to access such information or wishes to have it available to the public.

Certification: *Must my report be certified?*

While you must calculate and certify their emissions annually for each year they wish to report their emissions, you are not required to formally submit your Certification Opinion to the Registry for the first two years of your participation in the Registry. This flexibility is intended to allow you to fully understand the calculating, certification, and reporting processes before your emissions information is made available to the public.

See Chapter 13
Certification

Minimum Quality Standard*: What are the requirements for certifying my Emission Report?*

Any Emission Report submitted to the Registry must be free of material misstatement in order to be certified. It is possible that during the certification processes differences will arise between the emissions totals estimated by the Registry participant and those estimated by the certifier. These differences between participant and certifier estimations may be classified as either *material* (significant) or *immaterial* (insignificant). A discrepancy is considered to be material (significant) if the overall reported emissions differ from the overall emissions estimated by the certifier by 5% or more. A difference is immaterial (insignificant) if it is less than 5%.

Registry-Approved Certifiers: *Who must certify a GHG Emission Report?*

In order to accept your Emission Report into the Registry Database, it must be certified by an independent third-party that has been approved by the CEC and the Registry. A list of approved certifiers will be provided to all Registry participants and available on the Registry's website (**www.climateregistry.org**). The certification process is outlined in Chapter 13.

Part II What You Should Report

As you begin to prepare your annual GHG Emission Report to the Registry, you will first need to consider the geographic and organizational boundaries of your organization. That is, you will need to determine which sources of emissions are to be included in your report based on their location, your organizational structure, and operations. For many Registry participants, particularly firms that are wholly owned entities operating entirely within the State of California, establishing reporting boundaries will be straightforward. For participants whose operations consist of jointly owned entities and those with operations outside of California, the process may be more involved.

Part II is designed to help your organization assess what emissions and activities you should include in your report. **Chapter 1** begins at the broadest possible level—your report's geographic boundaries. It discusses options for reporting your organization's emissions within the borders of the United States or for those only within the state of California--the minimum requirement for reporting to the Registry.

After addressing geographic boundaries, **Chapter 2** focuses more narrowly on organizational boundaries. The basic unit of participation in the Registry is an entity in its entirety, such as a corporation or other legally constituted body, any city or county, state government agencies, and non-profit organizations. While entity-level reporting is required, the Registry strongly encourages organizations to report at the facility-level. Organizations that wholly own and fully control all of their GHG emission sources will simply report all of their material emissions to the Registry. For facilities that are owned or controlled by more than one organization, determining organizational boundaries may be more complicated.

Chapter 3 provides guidance on selecting a baseline year, if you wish to establish a baseline year against which to compare future emissions, and on adjusting your baseline over time to capture any changes in the size and scope of your organization.

After you have determined your geographic and organizational boundaries, and your emissions baseline, **Chapter 4** will help you consider the "operational boundaries" of your emissions, based on whether they are directly or indirectly caused by your organization. After you have categorized your emissions and defined operational boundaries, you will be ready to move onto estimation methods in Chapters 5-10.

Chapter 1 Geographic Boundaries

Ⓐ Ⓑ Ⓒ Ⓓ	Chapter 1 applies to all participant categories.
What you will find in Chapter 1	This chapter explains the options and requirements for determining the geographic scope of your GHG Emission Report.
Information you will need	You will need basic information about the location of your organization's facilities in the State of California and, if desired, throughout the U.S.
Cross-References	It may also be useful to refer to Chapter 2 on Organizational Boundaries as you examine your geographic boundaries.

Options for Defining the Geographic Scope of Your Report

The first step in determining what to report to the Registry is to decide on the geographic scope of your report. You have the option of reporting California-only emissions, or both California and nationwide GHG emissions.

National and California-Based Emissions

The Registry supports the most comprehensive reporting possible and thus encourages you to report emissions associated with all of your organization's activities in the United States. If you choose to report at the national level, you will also need to specifically report your California-based emissions. The Registry's web-based reporting software is designed to capture both your organization's national-level emissions and your California-only emissions separately so reporting both is easy. If you are reporting at the national level but do not presently have any emissions in California, please report zero California emissions on your reporting form.

California-Only Emissions

If you do not have operations or do not wish to report your emissions outside the State of California, please report your emissions for California-only. To estimate your California-only emissions you must identify those sources within your organization located in California. Emissions associated with the electricity purchased and consumed in buildings and manufacturing processes occurring in California should be included in the calculation of California-only emissions, regardless of the likely location of the power generation.

See Chapter 5
Indirect Emissions from Electricity

For the purposes of reporting California emissions to the Registry, you should report the total GHG emissions for mobile sources based in California regardless of whether the vehicles travel inside or outside of the state, or whether vehicle fuel was purchased inside or outside of California. Such vehicles include those your organization owns or leases. Vehicles registered by the California Department of Motor Vehicles are considered to be based in California.

See Chapter 6
Direct Emissions from Mobile Combustion

Worldwide Emissions

As many Registry participants have operations both in the U.S. and abroad—and because the issue of climate change knows no international borders—the Registry is considering options for incorporating worldwide GHG emissions reporting in the near future. Although at this time the Registry will not be accepting GHG emissions data from operations outside the U.S., you are encouraged to gather and retain this data for reporting to the Registry in subsequent years.

Determining Whether to Report California-only or Nationwide Emissions

There are several reasons why you may wish to complete a national-level report of your organization's emissions. Potential participants have expressed a variety of motivations for taking this approach, such as:

- An existing environmental management system already captures emissions at the national-level;
- A future Federal regulatory regime is likely to be national in scope;
- Corporate decision-making must look at the "big picture" when making efforts to improve efficiency and make least-cost reductions in GHG emissions;
- Environmental stewardship goals are nationwide (and often worldwide); and
- Private GHG trading opportunities are enhanced using nationwide emissions accounting.

You may also report your California emissions only. Examples of the rationale for taking this approach include the following:

- A participant has only California emissions;
- Completing a report for California only offers a good learning experience for implementing a more comprehensive corporate accounting scheme in the future;
- Conducting nation-wide accounting is simply too complex and burdensome at this time; and
- The participant owns and controls 100% of all operations in California, while having only partial ownership in operations outside of California, making California-only reporting more straightforward and less burdensome.

See Chapter 2
Organizational Boundaries

Example 1-1. Determining Geographic Boundaries: An Interstate Trucking Company with a Fleet Based in California

A trucking company purchases diesel fuel to operate its California-based trucks both within the State of California and outside the state. The estimation of carbon dioxide (CO_2) emissions is based on the total fuels purchased for operating the trucks in the fleet. If the participant chose to report methane (CH_4) and nitrous oxide (N_2O) emissions (which is a voluntary option for the first three years of reporting), those emissions are estimated based on the total distance traveled by the trucks. This same approach would apply to all types of mobile sources, including: on-road vehicles, off-road vehicles, locomotives, marine vessels, and aircraft.

If the trucking company is reporting California-only emissions, all fleet emissions would be reported as California emissions. If the company owned trucks that were based outside the State of California, and the company decided to report its U.S. emissions, then the non-California based trucks would be included in the Emission Report.

Chapter 2 Organizational Boundaries

A B C D	Chapter 2 applies to all participant categories.
What you will find in Chapter 2	This chapter considers the options and requirements for determining the organizational scope of your GHG Emission Report.
Information you will need	You will need information that will help you determine which sources of emissions are to be included in your organizational structure and operations, including information about joint ventures, subsidiaries, and similar entities.
Cross-References	It may also be useful to refer to Chapter 1 on Geographic Boundaries as you examine your organizational boundaries.

Options for Reporting Based on Organizational Boundaries

Reporting at the Entity Level

Once you have determined the geographic boundaries of your report, you should identify the material emissions within those boundaries that are attributable to facilities and operations that you own or control. For the purposes of this Protocol, the basic unit of participation in the Registry is an entity in its entirety, such as a corporation or other legally constituted body, any city or county, each state government agency, non-profit organizations, etc. While entity level reporting is required, the Registry strongly encourages you to report GHG emissions information at the facility level as part of your entity-level report. While the Registry does not currently accept project-level reports, it is working to develop a credible project-level reporting component in the future.

See Chapter 12
Reporting Your Emissions

Reporting Based on Organizational Boundaries

To define your organizational boundaries, you should inventory those facilities and operations that fall within your chosen geographic boundaries. For those facilities that are wholly owned, you should simply report all of the associated emissions. For those facilities that you have a partial ownership share in, lease, or hold an operating license on, you have two options for determining the share of emissions:

- **Option 1 – Management Control:** Report based on whether you hold management control of the facility or business activity.
- **Option 2 – Equity Share:** Report based on a fractional percentage or share of an interest in an entity based either on ownership interest.

These options assume that there are no other contractual ownership arrangements in place. If you are subject to contracts that define your ownership and/or your emissions responsibility, these arrangements should take precedent over the management control and equity share reporting options.

As described below, you can choose to report based on management control only, equity share, or both management control and equity share.

Rationale for Choosing Management Control

An important reason for choosing to report based on management control is that emissions reduction programs, regulations, and trading systems are often based on management control rather than equity ownership.

Rationale for Choosing Equity Share

In some industries, management control is not always the best measure of "control" or "influence" over a subsidiary or joint venture. In the oil and gas industry, for example, the financial interests of one company in another business entity can vary over time, thus making equity share reporting a more direct method of capturing organizational boundaries. In other cases, you may financially own an entity, but not hold the operating license.

Rationale for Choosing Both Management Control and Equity Share Reporting

Optimally, you should report your GHG emissions using both the management control and equity share approaches. Given the uncertainty of the exact nature of future GHG emissions trading or regulatory regimes, reporting using both methods would provide the greatest flexibility and use of your emissions data in the future.

Reporting Based on Management Control

Management control is defined as the ability of an entity to govern the operating policies of another entity or facility so as to obtain benefits from its activities. If you have management control over another entity, you should report 100% of the material emissions of that entity. The definition of management control applies to incorporated as well as to non-incorporated operations.

Any one or more of the following conditions establishes management control under this Protocol:

1. Entities or facilities are wholly owned by your organization;
2. Your organization owns over 50% of the voting interests of another entity;
3. Your organization controls more than one half of the voting rights of another entity or facility by virtue of an agreement with other investors;
4. Your organization governs the financial and operating policies of the other enterprise under a statute or an agreement or contract;
5. Your organization appoints and/or removes the majority of the members of the board of directors of another entity;
6. Your organization casts the majority of votes at a meeting of the board of directors; or
7. You lease a facility and directly purchase the electricity, fuel, or raw materials that result in greenhouse emissions at or from that facility.

In the case of ***joint control***, that is, 50% ownership by two entities, no individual has management control. If you have joint control over a facility, you should report by ***equity share***, i.e. based on your economic interest and/or benefit in the facility. In this case, you would report 50% of the controlled entity's emissions.

Under the management control reporting philosophy, if you have less than 50% ownership or control in an entity, you are exempt from reporting these emissions.

Table 2-1. Reporting Based on Management Control

Level of Control	Percent of Ownership	Percent of GHG Emissions to Report
Wholly owned	100%	100%
Not wholly owned but controlled (Financial control)	More than 50%	100%
Not wholly owned but controlled via other statute or agreement	Less than 50%	100%
Leased but purchasing fuel, electricity, or raw materials for facility	0%	100%
Jointly controlled	50%	50%
Significant influence	More than 20% and less than 50%	0%
Non-controlled	Less than 20%	0%

If you do not have management control of a facility or operation but wish to report emissions, you may do so on an equity share basis as described below.

Reporting on a Equity Share Basis

For those facilities and operations in which your share of ownership ranges from 1% to 99%, you may choose to report on an ***equity share basis***—either in addition to, or instead of, reporting based on management control. When reporting on a equity share basis, you should include the portion of the emissions from the facility or operations equal to your equity share of the total emissions. If your equity share in a facility or operation is less than 20%, you do not need to include the emissions from that facility or operation in your Emission Report. If more than one owner of a facility is a participant in the Registry, then each participating owner must agree in advance to report on an equity share basis. The collective reports of multiple owners should ensure that all applicable emissions are reported and that there is no double counting of participant emissions.

When reporting on an equity share basis, the entity with management control is not required to report all of the emissions associated with each facility. Instead, any entities that do not have management control may be asked to report some of the facility's emissions (based on their equity share.)

See Chapter 3
Establishing Your Baseline

Once established, the equity share method of reporting should be continued in subsequent Emission Reports. Any modifications to an equity share method that result in changes to emissions reported and changes to a participant's baseline should be clearly identified by the participant and approved by the Registry.

Table 2-2. Reporting Based on Equity Share	
Level of Ownership	**Percent of GHG Emissions to Report**
Wholly owned	100%
Not wholly owned but controlled (Financial control)	By equity share
Partially owned, equal to or more than 20% ownership	By equity share
Partially owned, less than 20% ownership	0%

Examples of Management Control vs. Equity Share Reporting

The following examples are provided to assist you as you determine whether to report using the management control or the equity share basis. Remember, although these examples are provided for individual facilities, you should choose either or both the management control or the equity share approach for your report in its entirety.

Example 2-1. Company with 100% Ownership and Voting Interests

Company A has 100% ownership and voting interest, and reports 100% of the emissions for both management control and equity share.

Participant	Facility	Management Control Reporting Requirements	Equity Share Reporting Requirements
Company A	100% ownership & voting interest	100%	100%
Company B	No ownership	0%	0%

Example 2-2. Companies with Ownership Divided 60%-40%

Company A has 60% ownership and management control. Company B has 40% ownership of the facility, and does not have management control. Under management control, Company A would report 100% of GHG emissions because it has more than 50% control. Under equity share, Company A and Company B would report 60% and 40% of GHG emissions, based on share of ownership and voting interest.

Participant	Facility	Management Control Reporting Requirements	Equity Share Reporting Requirements
Company A	60% ownership & voting interest	100%	60%
Company B	40% ownership & voting interest	0%	40%

Example 2-3. Companies with Ownership Divided 60%-40% and Voting Interests Divided 45%-55%

Company A has 60% ownership of the facility and a 45% voting interest. Company B has 40% ownership of the facility and a 55% voting interest. Company B has management control. Under management control, Company B would report 100% of GHG emissions and Company A would report none, because Company B has a majority voting interest. Under equity share, Company A would report 60% of GHG emissions and Company B would report 40%, based on ownership share.

Participant	Facility	Management Control Reporting Requirements	Equity Share Reporting Requirements
Company A	60% ownership & 45% voting interest	0%	60%
Company B	40% ownership & 55% voting interest	100%	40%

Example 2-4. Two Companies with 50% Ownership Each

Company A and Company B each have 50% ownership of the facility. Each reports 50% of GHG emissions under both management control and equity share.

Participant	Facility	Management Control Reporting Requirements	Equity Share Reporting Requirements
Company A	50% ownership & voting interest	50%	50%
Company B	50% ownership & voting interest	50%	50%

Example 2-5. Three Companies with Ownership Divided 55%-30%-15%

Company A has 55% ownership of the facility, Company B has 30% ownership of the facility, and Company C has 15% ownership. Under management control, Company A would report 100% of GHG emissions because it holds a majority interest in the control of the operation, and Companies B and C would not report. Under equity share, each company would report according to its equity share of ownership and voting interests. Since Company C owns less than 20%, it does not have to report any emissions.

Participant	Facility	Management Control Reporting Requirements	Equity Share Reporting Requirements
Company A	55% ownership & voting interest	100%	55%
Company B	30% ownership & voting interest	0%	30%
Company C	15% ownership & voting interest	0%	0%

Key Questions

See Chapter 1
Geographical Boundaries

Geographic Boundaries: *How should I reconcile my organizational and geographic boundaries for my GHG Emission Report?*

Your choice of a geographic boundary for your report may be affected by the number and diversity of facilities for which you have partial ownership and the method you select for accounting for those emissions. You should consider organizational boundaries and geographic boundaries in tandem if you have partial ownership of multiple facilities.

Partnerships: *What if no one part of my organization has management control or equity share over 20%?*

As you will see below, situations may exist in which no party in your organization has sufficient management or ownership interest to claim responsibility for reporting. For example, in a Limited Liability Partnership (LLP), it is possible that no single entity would have a controlling or majority equity share. In such a case, the collective partners could come to a mutual agreement to divide the responsibilities for reporting GHG emissions to the Registry. However, as this Protocol is currently designed, no one in your organization would have responsibility for reporting.

Your Subsidiaries: *Should I report for my organization's subsidiaries?*

A subsidiary company is one in which a parent corporation owns more than 50% of the stock (and thus would typically have majority voting rights). Because it meets the criteria for management control, the parent company should report all of the subsidiary's emissions. Holding companies (corporations that are made up of several other corporations) would report following the same management control approach described above. If the holding company controls several subsidiaries, it would report the total emissions from each of its subsidiaries.

Parent Company Not Reporting: *If our parent corporation is not reporting, can we participate?*

If your organization is a subsidiary that is a corporation or other legally constituted body, you may join the Registry as a separate participant, if the parent company is not already participating in the Registry. However, corporations that report baselines and annual results as subsidiaries must clearly define the parent corporation to the Registry. The parent company itself need not participate in the Registry merely because one or more of its subsidiaries chooses to participate.

Leased Facilities: *How do I account for GHG emissions at a facility I lease?*

Emissions from industrial operations in a leased building, emissions from fuel consumed by leased vehicles, emissions from leased equipment, and electricity metered and paid for by the participant in a leased office building should be reported in the same manner as if you wholly-owned the facilities, vehicles, equipment, or building. If office space or building space is rented or leased, and heating, electricity, cooling, or other utilities are paid for by the landlord and not separately metered, emissions associated with these items need not be reported. The landlord would report these emissions if the landlord participates in the Registry. However, participants are encouraged to estimate the amount of square feet not reported, and to estimate associated indirect emissions.

Joint Ownership: *What if I hold the operating license for a facility?*

For some sectors such as the petroleum industry, it is common to have joint ownership with a single operator. Holding the operating license may not be a sufficient condition for being able to direct the operating policies of an entity or facility. Therefore the conditions for management control listed above should determine what emissions you should report, not whether you hold the operating license.

Chapter 3 Establishing and Updating Your Baseline

Ⓐ Ⓑ Ⓒ Ⓓ	Chapter 3 applies to all participant categories.
What you will find in Chapter 3	This chapter considers the options and requirements for determining your organization's baseline.
Information you will need	You will need information that will help you determine the basis for selecting a baseline year, such as, historic emissions data to determine the earliest year (back to 1990) for which you can assemble the required emissions data to complete an Emission Report. You will also need to consider any information, if applicable, describing new or recent mergers and acquisitions, divestitures, outsourcing and insourcing of services, and other changes to your organization affecting your total emissions.
Cross-References	You will need to refer to all applicable chapters relating to quantifying your emissions (Chapters 5-10) in determining your baseline.

Establishing Your Baseline

Purpose of Establishing a Baseline

You have the option to establish an emissions baseline with the Registry or to report without one. A **baseline** is a datum or reference point (annual emissions in a selected base year) against which to measure GHG emissions performance over time—i.e., to gauge decreases or increases in total emissions from the baseline. Your baseline should identify and account for direct and indirect emissions separately. This baseline should remain static over time, changing only to accommodate structural changes in your organization. Methods for capturing those structural changes are described later in this chapter.

See This Chapter
Examples Addressing Structural Changes

Selecting a Baseline

You may select any year from 1990 forward as your baseline. If you choose to establish a baseline, that baseline should include all emissions under the geographic and organizational boundaries you determined under chapters 1 and 2 above. After establishing your baseline you should report your certified emissions results for each subsequent year. If, for some reason, your organization's participation in the Registry lapses temporarily, you should report emissions for all intervening years or establish a new baseline. The Emission Reports submitted to the Registry should have a sequential accounting of each year's emissions beginning with your baseline and ending with the most recent year for which you provided a report.

If your organization's boundaries and emissions do not change much, your baseline will typically remain fixed over time. Generally, your baseline will (by default) be the first year that you report your emissions. However, you do not have to declare that your first year of data is your baseline, and you may always enter emissions data for a year that precedes the first

year you reported your emissions. Consequently, you can establish an earlier baseline later into the process.

Rationale for Selecting a Baseline

There are several issues you may wish to explore when considering whether and for what year to establish a baseline, including whether:

- You have sufficient data to certify your emissions against the requirements in the General Reporting Protocol for the baseline year;
- Your organization is sufficiently comparable in its composition and structure to support a meaningful comparison with the baseline year;
- You wish to select a baseline year that minimizes or maximizes your emissions relative to most recent levels, and what are the benefits of doing so;
- You are interested in providing the Registry with sufficient documentation to promote GHG emission reductions your organization has achieved.

Your baseline should not be adjusted for the organic growth or decline of your organization. **Organic growth or decline** refers to the increase or decrease in production output, changes in product mix, plant closures, and the opening of new plants that are not the result of changes in the structure of the participant's organization or the result of shifting operations into or out of California or the U.S.

Updating Your Baseline

Conditions for Updating Your Baseline

After you have completed and submitted your first year GHG Emission Report to the Registry, you have the option of updating your baseline in subsequent reporting years. The purpose of these adjustments is to ensure that trends in your organization's emission levels are the result of net increases or decreases in emissions over time, not the result of changes in your organizational structure or reporting method. This Protocol identifies six circumstances that would require you to update your baseline:

Structural Changes in Your Organization

1. Mergers and Acquisitions;
2. Divestitures;
3. Outsourcing – contracting activities to outside parties that were previously conducted internally;
4. Insourcing – conducting activities internally that were previously contracted to outside parties;

Shifting of Emissions Sources

5. A shift in the location of an emission sources (into or out of the U.S. or the State of California, depending on your geographic boundaries); and

Improved GHG Accounting Methodologies

6. Fundamental changes in generally accepted GHG emissions accounting methodologies.

Adjustment Change Threshold

For many organizations, particularly large ones, mergers, acquisitions, and divestitures, as well as the other listed organizational changes, are common occurrences. Rather than requiring baseline adjustments whenever any changes occur in your organization, however insignificant, you need only adjust your baseline whenever you estimate that the *cumulative effect* of such changes affects your organization's total reported emissions by plus or minus 10%.

See This Chapter
Example 3-7
Cumulative Changes to Total Emissions

In some situations, year-to-year changes to total emissions resulting from structural or other changes to your organization may fall below the 10% threshold for updating your baseline. You will need to update your baseline, however, if and when the cumulative effect is greater than 10%. An example of cumulative changes to total emissions is provided in Example 3-7, below.

Examples on Updating Your Baseline

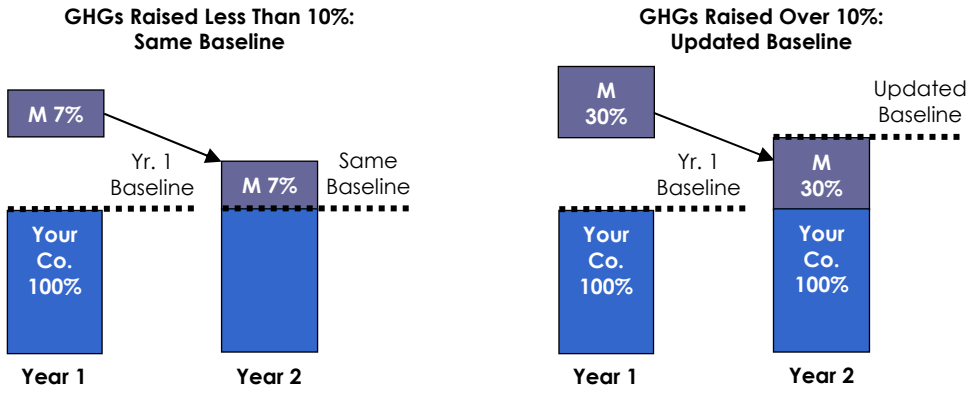
The examples below illustrate how your baseline should be adjusted under various scenarios.

Example 3-1. Mergers and Acquisitions

Your organization merges with Mergitrex, raising your total GHG emissions by over 10%.

Adjust your baseline emissions to include Mergitrex's baseline emissions (provided Mergitrex existed in your baseline year). If Mergitrex did not exist in the baseline year, do not adjust your baseline emissions. If your merger with Mergitrex led to less than a 10% increase in GHG emissions, do not adjust your baseline emissions unless the acquisition, when combined with other changes to the organization, changes your annual emissions by more than 10%.

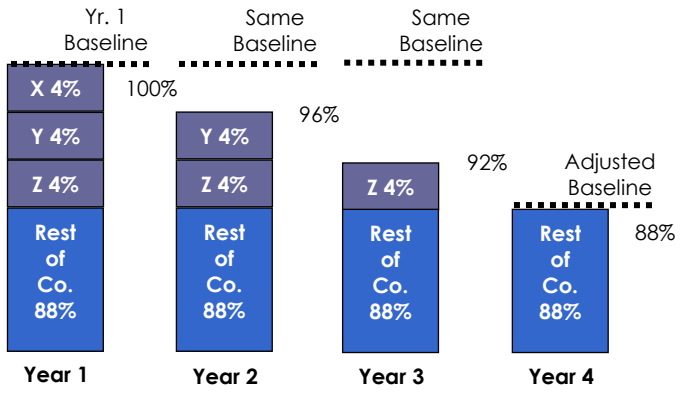
If Mergitrex does not have sufficient data to establish baseline emissions for your organization's baseline year, you will need to select a new baseline year for which both companies have sufficient data to allow the baseline emissions to be certified.



Example 3-2. Divestitures

Your organization divests three divisions over the second, third, and fourth reporting years. Each of these divisions account for 4% of your GHG emissions, for a 12% total reduction in emissions by year four.

Because the cumulative effect of these divestitures reduces your company's emissions by more than 10% in year four, you will need to adjust your baseline by subtracting the emissions of the three divisions from those reported during your baseline year and adjust the baseline accordingly.



Example 3-3. Outsourcing

Your organization contracts out activities previously included in your baseline.

If your organization contracts out activities previously included in its baseline inventory, you should treat these activities similar to a divestiture. Emissions associated with the outsourced activity should now be reported as indirect emissions and subtracted from the baseline direct emissions. There is no need to adjust your baseline for outsourcing of activities that did not exist during your baseline year.

As part of your annual GHG emissions reporting, you will attest that your organization has not outsourced any emissions, or, if you have, that these emissions have been subtracted from your baseline or that they fall below the minimal level.

Example 3-4. Insourcing

Your organization begins to conduct business activities not previously included in its baseline inventory.

Insourcing is the converse of outsourcing. You should treat these activities as an acquisition. Emissions associated with the insourced activity should be reported as direct emissions and not included with indirect emissions. You will not need to make adjustments to the baseline for insourcing of activities that began after your baseline year unless direct emissions increase by 10% or more.

Example 3-5. Shifting the Location of Emissions Sources

Your organization moves operations into or out of the U.S.

If you shift operations outside of California and/or the U.S. and this shift reduces your reported emissions by 10% or more, or this shift, in combination with other changes to your organizational structure changes your emissions by 10% or more, you subtract the emissions of the shifted operations from your baseline. Shifts of operations into the U.S. should be addressed by increasing your baseline to include emissions from those operations. Your California-only baseline should be adjusted similarly for shifts of operations outside of California or shifts of operations from outside of California into California.

Example 3-6. Change in Emissions Accounting Methodologies

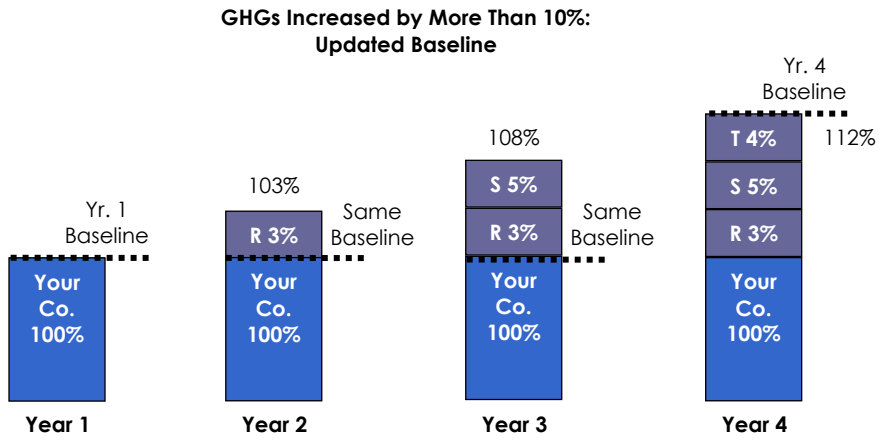
Your organization employs a new methodology that complies with a revision of this Protocol or is approved as a revision by the Registry board.

Your baseline emissions should be recalculated for any changes in calculation methodologies if such changes will alter your total emissions in the current reporting year more than 10%. This ensures a comparative time-series of emission estimates.

Example 3-7. Cumulative Changes to Total Emissions

Your organization acquires three companies over three years, raising your GHG emissions by 12%.

Your company acquires Reyes Rockets, Sierra Spaceworks, and Trinity Telescopes in reporting year two, three, and four representing GHG emission increases of 3%, 5%, and 4%, respectively. While these acquisitions individually represent less than the required 10% increase for a baseline adjustment, they amount to a 12% cumulative increase in total emissions. Thus, you would be required to update your company's baseline in year four.



Chapter 4 Operational Boundaries: Direct vs. Indirect Emissions

A B C D	Chapter 4 applies to all participant categories.
What you will find in Chapter 4	This chapter provides guidance on determining what direct and indirect GHG emissions your organization must report to the Registry.
Information you will need	You will need information about the size and nature of GHG emitting operations throughout your organization in order to determine which emissions are directly and which are indirectly caused by your organization.
Cross-References	It will be useful to consider your geographical and organizational boundaries addressed in Chapters 1 and 2, and de minimis and material emissions addressed in Chapter 11.

The next step in compiling your GHG Emission Report is to divide your emission sources into emission source categories. Emission sources can be divided into direct and indirect emissions.

Direct emissions are those emissions from sources that are owned or controlled by your organization. You must report all of your material direct emissions. These emissions include:

- **Stationary combustion** for the production of heat, steam, or electricity (on site);
- **Mobile combustion** (i.e., from cars, trucks, rail, air, and other transport) owned or controlled by your organization and used for moving raw materials, finished products, supplies, or people;
- **Process emissions**, such as emissions from the production of cement, adipic acid, and ammonia, as well as emission from agricultural processes; and
- **Fugitive emissions** such as emissions of methane leaks from pipeline systems or leaks of HFCs from air conditioning systems.

Indirect emissions are emissions that occur because of your organization's actions, but are produced by sources owned or controlled by another entity.[4] You should report all of your company's indirect emissions from the following sources:

- Purchased electricity;
- **Co-generated heat or electricity** that you purchase from combined heat and power (CHP) plants;
- Purchased steam; and

[4] *Id.*, page 21.

- Purchased heating or cooling obtained from district heating/cooling plants.

Additionally, you are encouraged to report other non-required indirect GHGs. While the Registry does not currently provide guidance for estimating emissions from these optional sources, it is working to develop calculation methodologies for these emissions. Other sources of indirect emissions that you may choose to report include:

- off-site waste disposal, including transport;
- employee commuting, including business travel;
- production of purchased raw materials, including transport;
- product use;
- product disposal; and
- outsourced activities and contracting.

For many participants, the only material emissions of GHGs you will have to report are indirect emissions from the purchase and consumption of electricity. Thus, this Protocol begins its series of emissions estimation methods with indirect emissions from purchased electricity. The next most common emission sources follow, including direct emissions from mobile sources and direct emissions from stationary combustion.

Coming Soon! Additional Guidance on Other Indirect Sources of Emissions

The Registry is currently planning to produce additional guidance on estimating emissions from additional indirect sources, like the ones listed above.

Part III Quantifying Your Emissions

Having determined your geographic, organizational, and operational boundaries and your emission baseline (if you choose to have one), you are ready to begin estimating your organization's overall emissions. Part III provides you with the technical methodologies needed to quantify the GHG emissions you will be reporting to the Registry. Chapters 5 though 10 provide estimation methods for the following categories of emissions:

- **Chapter 5 –** Indirect Emissions from Electricity;
- **Chapter 6 –** Direct Emissions from Mobile Combustion;
- **Chapter 7 –** Direct Emissions from Stationary Combustion;
- **Chapter 8 –** Indirect Emissions from Co-Generation, Imported Steam and District Heating or Cooling Direct Process Emissions;
- **Chapter 9 –** Direct Process Emissions; and
- **Chapter 10 –** Direct Fugitive Emissions.

Should you have difficulty using these estimation methods, please contact the Registry technical assistance hotline at **1-877-CO2-CCAR.** Technical questions may also be emailed to: **help@climateregistry.org**.

Registry Technical Assistance
1-877-CO2-CCAR

CARROT Application & Demonstration
www.climateregistry.org

Coming Soon! Normalized Output Measures

GHG emissions are sometimes reported on a normalized basis instead of, or in addition to, reporting in absolute terms. Normalized emissions are emissions divided by some measure of output for the reporting entity. The specific output measure depends on the nature of the organization that is reporting and may range from physical units of output (e.g., pound of cement for a cement plant) to economic output (e.g., dollars of revenue for a diversified manufacturer). Reporting normalized emissions allows trends in the emissions intensity of an activity to be gauged by removing the effects of changing outputs on the results. The Registry will soon convene industry workgroups to help determine the best metrics for each sector. If you are interested in participating in such groups, please call the Registry's Technical Director at 213-891-1444. Until then, you can report your own efficiency metrics, which do not need to be certified. Sample efficiency metrics are listed in Appendix D.

Estimating De Minimis Emissions

In some cases, it may be difficult to quantify absolutely all of your emissions. To focus your calculation and reporting activities on your material emissions, the Registry allows you to determine that up to 5% of your emissions are de minimis, or non-material. In some cases, it will be easy to prove that certain sources and/or gases will be de minimis compared to your total emissions.

You must estimate your total emissions to calculate the maximum amount of de minimis emissions (5% of total emissions). You can estimate your likely de minimis emissions using rough upper bounds rather than more precise estimates (since the amounts may be insignificant even as upper bounds). After determining the 5% threshold and your likely de minimis emissions, you can then confirm and document your de minimis emissions.

You may use alternative methods to demonstrate that emissions are de minimis. For example, if your emissions come only from electricity and fuel consumption, it would be sufficient to show that the emission factors for methane (CH_4) and nitrous oxide (N_2O), when multiplied by their global warming potentials and added together, are less than 5% of the corresponding emission factor for carbon dioxide (CO_2). Assuming you deemed no other type of emissions to be de minimis, the total de minimis emissions would be less than the 5% threshold.

Chapter 5 Indirect Emissions from Electricity Use

Ⓐ Ⓑ Ⓒ Ⓓ	Chapter 5 applies to all participant categories. **Any organization** consuming electricity from an electric utility should complete this chapter. **Power generators** that are self-powered and do not consume electricity from outside sources will not need to complete this chapter unless they are a net positive emissions importer.
What you will find in Chapter 5	This chapter provides guidance on calculating your indirect emissions from electricity consumption.
Information you will need	Most organizations will simply need to refer to monthly utility electricity bills for information about electricity consumed.
Cross-References	This chapter may be useful in completing Chapter 8 on quantifying indirect emissions from co-generation, steam, or district heating or cooling.

Chapter Overview

Nearly all companies are likely to have some indirect emissions associated with the purchase and use of electricity. In many cases, indirect emissions from electricity use may be the only GHG emissions that a company will need to report to the Registry. To calculate indirect emissions from electricity use, you should follow this simple five-step process:[5]

1. Determine your annual electricity use in each applicable state where you have operations;
2. Select the appropriate adjusted electricity emission factors that apply to the electricity used;
3. Determine your total annual emissions and convert to metric tons;
4. Convert non-CO_2 gases to carbon dioxide equivalent (CO_2e); and
5. Total the sum of all CO_2 and CO_2e gases emitted from electricity use.

The generation of electricity through the combustion of fossil fuels typically yields carbon dioxide, and to a much smaller extent nitrous oxide and methane. This Protocol provides emission factors for all three. However, if you are reporting only indirect emissions from electricity use, both nitrous oxide and methane are likely to be de minimis.

See This Chapter
Equation 5a
Total Emissions from Indirect Electricity Use

[5] Note, the Registry has simplified this process by combining standard electricity emission factors with the estimated electricity transmission and distribution loss factor of 8% (i.e., for electricity lost between the generator and consumer). Thus, only a single calculation is needed using the adjusted emission factors. This Protocol incorporates a default factor for transmission loss and distribution losses of 8% into its adjusted electricity emission factors. Non-adjusted electricity emission factors are available in Appendix C.

❑ Step 1: Determine annual electricity consumption.

Your monthly utility bills contain the number of kilowatt-hours consumed by your operations. A ***kilowatt-hour*** (kWh) is a metric or the energy used by electric loads, such as lights, office equipment, air conditioning, or machinery. Depending on the organization of your company and its facilities, you may need to aggregate multiple electricity bills. Collect your monthly bills and record the kilowatt-hours consumed each month. Then, add together your electricity consumption for the year. (Monthly accounting may be necessary in order to calculate emissions if you are using emission factors that vary seasonally.)

❑ Step 2: Select adjusted electricity emission factors that apply to the electricity used.

An ***emission factor*** represents the amount of GHGs emitted per unit of electricity consumed, and is reported in pounds per kilowatt-hour (lbs/kWh). Optimally, since emissions vary depending on the sources of fuel for the electricity—e.g., coal, fuel oil, natural gas, nuclear, biomass, wind, hydrological, solar, or geothermal—you would obtain specific emission factors from the electric utility or independent power producer that supplies your electricity. However, as a practical matter it is often very difficult to determine the exact fuel source for your electricity. Thus, state-average emission default factors for electricity consumption are generally used to determine emissions based on electricity consumed.

Since some electricity is typically lost between the generation station and the consumer, these transmission and distribution (T&D) losses add to the total electricity that must be generated to supply you with each kilowatt-hour. This Protocol assumes across the board that these losses amount to 8% of the total electricity generated at a power plant.

To simplify the calculation process, this Protocol combines standard average electricity emission factors that are typically used in emissions estimation with a T&D loss factor of 8%. These adjusted emission factors are provided in Table 5-1. (Note, a list of non-adjusted average electricity emission factors is provided in Appendix C if you would prefer to use those in combination with more exact T&D loss factors. In addition, if you can obtain emission factors specific to the supplier of your electricity, you are encouraged to use those factors in calculating your indirect emissions from electricity generation.)

See Appendix C Table C-1
Unadjusted Electricity Emission Factors

Coming Soon! Utility- and Season- Specific Emission Factors for California

The California Energy Commission is currently working to complete specific emission factors based on California utility generation mix.

Table 5-1 Adjusted Average Electricity Emission Factors by State and Region[6]

Region/ State	Carbon Dioxide Emission Factor			Methane	Nitrous Oxide
	lbs/kWh	short tons/MWh	metric tons/MWh	lbs/MWh	lbs/MWh
Pacific Contiguous	**0.4891**	**0.2435**	**0.2207**	**0.00576**	**0.00402**
California	0.6630	0.3293	0.2989	0.00728	0.00402
Oregon	0.3043	0.1533	0.1380	0.00359	0.00370
Washington	0.2717	0.1337	0.1207	0.00402	0.00435
Pacific Non-contiguous	**1.6957**	**0.8478**	**0.7685**	**0.01750**	**0.01620**
Alaska	1.5000	0.7500	0.6804	0.00739	0.00967
Hawaii	1.8043	0.9033	0.8196	0.02326	0.01989
Mountain	**1.6957**	**0.8489**	**0.7707**	**0.01174**	**0.02565**
Arizona	1.1413	0.5707	0.5174	0.00739	0.01674
Colorado	2.0978	1.0467	0.9489	0.01380	0.03141
Idaho	0.0326	0.0152	0.0141	0.00870	0.00359
Montana	1.5543	0.7793	0.7065	0.01174	0.02467
Nevada	1.6522	0.8250	0.7478	0.00978	0.02120
New Mexico	2.1957	1.0967	0.9946	0.01424	0.03217
Utah	2.0978	1.0511	0.9543	0.01457	0.03348
Wyoming	2.3370	1.1663	1.0576	0.01598	0.03674
West-North Central	**1.8804**	**0.9391**	**0.8522**	**0.01380**	**0.02924**
Iowa	2.0435	1.0228	0.9283	0.01500	0.03239
Kansas	1.8261	0.9152	0.8304	0.01217	0.02761
Minnesota	1.6522	0.8283	0.7511	0.01707	0.02685
Missouri	2.0000	1.0000	0.9076	0.01370	0.03130
Nebraska	1.5217	0.7609	0.6902	0.01033	0.02380
North Dakota	2.4348	1.2185	1.1054	0.01598	0.03685
South Dakota	0.8696	0.4337	0.3935	0.00576	0.01315
West-South Central	**1.5543**	**0.7761**	**0.7043**	**0.00946**	**0.01663**
Arkansas	1.4022	0.6989	0.6348	0.01359	0.02207
Louisiana	1.2826	0.6402	0.5804	0.01022	0.01217
Oklahoma	1.8696	0.9359	0.8489	0.01196	0.02424
Texas	1.5870	0.7957	0.7217	0.00837	0.01587
East-North Central	**1.7717**	**0.8859**	**0.8043**	**0.01337**	**0.02793**
Illinois	1.2609	0.6326	0.5739	0.00891	0.01957
Indiana	2.2609	1.1283	1.0239	0.01554	0.03511
Michigan	1.7174	0.8587	0.7793	0.01587	0.02717
Ohio	1.9565	0.9783	0.8880	0.01413	0.03130
Wisconsin	1.7826	0.8924	0.8098	0.01500	0.02826
East-South Central	**1.6196**	**0.8109**	**0.7359**	**0.01391**	**0.02609**
Alabama	1.4239	0.7130	0.6467	0.01489	0.02424
Kentucky	2.1848	1.0913	0.9902	0.01522	0.03489
Mississippi	1.4022	0.7033	0.6380	0.01435	0.01793
Tennessee	1.4130	0.7043	0.6391	0.01141	0.02304
New England	**1.0652**	**0.5337**	**0.4848**	**0.02250**	**0.01587**
Connecticut	1.0217	0.5120	0.4641	0.01891	0.01304
Maine	0.9239	0.4630	0.4196	0.06141	0.02935
Massachusetts	1.3913	0.6946	0.6293	0.01891	0.01728
New Hampshire	0.7391	0.3707	0.3370	0.01870	0.01533
Rhode Island	1.1413	0.5717	0.5185	0.00739	0.00511
Vermont	0.0326	0.0152	0.0141	0.01043	0.00424
Mid Atlantic	**1.1304**	**0.5652**	**0.5120**	**0.01011**	**0.01576**
New Jersey	0.7717	0.3837	0.3478	0.00837	0.00859
New York	0.9348	0.4663	0.4228	0.00880	0.00967
Pennsylvania	1.3696	0.6870	0.6239	0.01163	0.02207
South Atlantic	**1.4674**	**0.7326**	**0.6652**	**0.01380**	**0.02250**
Delaware	1.9891	0.9946	0.9022	0.01337	0.02467

[6] *Id.*

Region/ State	Carbon Dioxide Emission Factor			Methane lbs/MWh	Nitrous Oxide lbs/MWh
	lbs/kWh	short tons/MWh	metric tons/MWh		
Florida	1.5109	0.7576	0.6870	0.01630	0.01957
Georgia	1.4891	0.7424	0.6728	0.01402	0.02457
Maryland*	1.4891	0.7424	0.6739	0.01283	0.02239
North Carolina	1.3478	0.6750	0.6120	0.01141	0.02207
South Carolina	0.9022	0.4533	0.4109	0.00989	0.01576
Virginia	1.2609	0.6326	0.5739	0.01489	0.02087
West Virginia	2.1522	1.0739	0.9750	0.01489	0.03435
U.S. Average	**1.4565**	**0.7261**	**0.6587**	**0.01207**	**0.02087**

* Includes the District of Columbia.

Note: All emission factors in this table have been adjusted to include a T&D loss factor of 8%. The original, non-adjusted state-level electricity generation emission factors prepared by the Energy Information Administration are provided in Appendix C on page C.1. All emission factors for electricity generation were derived based on higher heating values (HHV). These state-level electricity generation emission factors represent average emissions per kWh or MWh generated by utility and non-utility electric generators for the 1998-2000 time period. EIA's Voluntary Reporting of Greenhouse Gases (1605(b)) Program believes these factors provide reasonably accurate default values for power generated in a given state. However, reporters should use these state- and regional-level factors only if utility-specific or power pool-specific emission factors are not available.

Source: Energy Information Administration, *Updated State-level Greenhouse Gas Emission Factors for Electricity Generation 1998-2002* (April 2002), see **http://www.eia.doe.gov/oiaf/1605/techassist.html**.

❑ Step 3: Determine total annual emissions and convert to metric tons.

See Appendix B
Common Conversion Factors

Multiply the electricity use in kilowatt-hours from Step 1 by the emission factors for carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) from Step 2. To convert pounds into metric tons, divide the total by 2204.62 lbs/metric ton. To convert short tons to metric tons, divide the total by 1.1023 short tons/metric ton. (Totals for methane and nitrous oxide may be reported in pounds.)

Equation 5a	Total Emissions from Indirect Electricity Use					
Total Emissions (metric tons)	=	Electricity Use (kWh)	x	Adjusted Electricity Emission Factor (**lbs**/kWh)	÷	2,204.62 lbs/metric ton
			or			
Total Emissions (metric tons)	=	Electricity Use (kWh)	x	Adjusted Electricity Emission Factor (**short tons**/kWh)	÷	1.1023 short tons/metric ton
			or			
Total Emissions (metric tons)	=	Electricity Use (kWh)	x	Adjusted Electricity Emission Factor (**metric tons**/kWh)		

❑ Step 4: Convert Non-CO_2 Emissions to CO_2e and sum the total.

See Table 5-2
Global Warming Potential Factors

Use the IPCC Second Assessment Report (SAR) global warming potential factors from Table 5-2 in this Chapter to convert methane and nitrous oxide to carbon dioxide equivalent. (See Equation 5b on the next page.) Sum the total pounds of CO_2 and CO_2e emitted. Note, if non-CO_2 gases are de minimis when converted to CO_2e, you do not need to report them to the Registry.

Converting to CO_2 Equivalent

To incorporate and evaluate non-CO_2 gases in your GHG emissions inventory, the mass estimates of these gases will need to be converted to CO_2 equivalent. To do this, multiply the emissions in units of mass by the GHG's global warming potential (GWP). Table 5-2 below lists the 100-year GWPs to be used to express emissions on a CO_2 equivalent basis. Equation 5b provides the basic calculation required to determine CO_2e from the total mass of a given GHG using the GWPs published in the IPCC Second Assessment Report.

Equation 5b	Converting Mass Estimates to Carbon Dioxide Equivalent			
Metric Tons of CO_2e	=	Metric Tons of GHG	x	GWP (SAR, 1996)

Table 5-2 Comparison of GWPs from the IPCC's Second and Third Assessment Reports

Greenhouse Gas	GWP (SAR, 1996)	GWP (TAR, 2001)
CO_2	1	1
CH_4	21	23
N_2O	310	296
HFC-123	11,700	12,000
HFC-125	2,800	3,400
HFC-134a	1,300	1,300
HFC-143a	3,800	4,300
HFC-152a	140	120
HFC-227ea	2,900	3,500
HFC-236fa	6,300	9,400
HFC-43-10mee	1,300	1,500
CF_4	6,500	5,700
C_2F_6	9,200	11,900
C_3F_8	7,000	8,600
C_4F_{10}	7,000	8,600
C_5F_{12}	7,500	8,900
C_6F_{14}	7,400	9,000
SF_6	23,900	22,000

Source: U.S. Environmental Protection Agency, *U.S. Greenhouse Gas Emissions and Sinks: 1990-2000* (April 2002).

Box 5-1. Using Global Warming Potentials from the IPCC's Second Assessment and Third Assessment Reports

Global Warming Potentials (GWPs) were developed by the Intergovernmental Panel on Climate Change (IPCC) as a method for quantifying the globally averaged relative radiative forcing effects of a given GHG, using carbon dioxide as the reference gas. In 1996, the IPCC published a set of GWPs for the most commonly measured greenhouse gases in its Second Assessment Report (SAR). As part of the United Nations Framework Convention on Climate Change (UNFCCC), these GWPs were adopted for national level inventory reporting.

In 2001, the IPCC published its Third Assessment Report (TAR). In it, the IPCC adjusted GWPs to reflect new information on atmospheric lifetimes and an improved calculation of the radiative forcing of carbon dioxide, the reference gas. However, these new GWPs have not been adopted at this time by international convention and the U.S. national emissions inventory is submitted using the GWPs from the Second Assessment Report. In order to maintain consistency with international standards, the Registry requires participants to use GWPs from SAR. The Registry will update these GWPs if and when the Third Assessment Report is adopted as international convention. A comparison of changes for key GHGs is provided in Table 5-2 on the previous page.

Example: Indirect Emissions from Electricity Use

Costlo Clothing Distributors

Costlo is a discount retail clothing chain with two outlets in California, one in Oregon, and one in Arizona. The company is a Category A organization that only purchases electricity and has no other GHG emissions.

Step 1: Determine annual electricity consumption.

Table 5-3. Determine Annual Electricity Consumption

State	Power Generator	Annual Electricity Purchases (kWh)
California	Los Angeles Dept. of Water and Power (LADWP)	1,600,000
California	San Diego Gas and Electric	1,200,000
Oregon	Portland Gas and Electric	600,000
Arizona	Arizona Public Service	800,000

Step 2: Select adjusted electricity emission factors that apply to the electricity used.

Table 5-4. Select Adjusted Electricity Emission Factors

State	Power Generator	Annual Electricity Purchases (kWh)	CO_2 lbs/kWh	CH_4 lbs/kWh	N_2O lbs/kWh
California	LADWP	1,600,000	0.6630	0.00728	0.00402
California	San Diego Gas and Electric	1,200,000	0.6630	0.00728	0.00402
Oregon	Portland Gas and Electric	600,000	0.3043	0.00359	0.00370
Arizona	Arizona Public Service	800,000	1.1413	0.00739	0.01674

Step 3: Determine total annual emissions and convert to metric tons.

Equation 5a	Total Carbon Dioxide (CO_2) Emissions for Electricity Use from Each Facility							
Total Emissions (lbs)	=	Electricity Use (kWh)	x	Adjusted Emission Factor (lbs CO_2/kWh)	÷	2,204.62 lbs/metric ton		
LADWP	=	1,600,000 kWh	x	0.6630 (lbs/kWh)	÷	2,204.62 lbs/metric ton	=	481.17 metric tons CO_2
San Diego Gas and Electric	=	1,200,000 kWh	x	0.6630 (lbs/kWh)	÷	2,204.62 lbs/metric ton	=	360.88 metric tons CO_2
Portland Gas and Electric	=	600,000 kWh	x	0.3043 (lbs/kWh)	÷	2,204.62 lbs/metric ton	=	82.82 metric tons CO_2
Arizona Public Service	=	800,000 kWh	x	1.1413 (lbs/kWh)	÷	2,204.62 lbs/metric ton	=	414.15 metric tons CO_2
						Subtotal	=	**1,339.02 metric tons CO_2**

Equation 5a	Total Carbon Dioxide (CO_2) Emissions for Electricity Use from Each Facility							
Total Emissions (lbs CO_2)	=	Electricity Use (kWh)	x	Adjusted Emission Factor (lbs CH_4/kWh)	÷	2,204.62 lbs/metric ton		
LADWP	=	1,600,000 kWh	x	0.00728 (lbs/kWh)	÷	2,204.62 lbs/metric ton	=	5.2835 metric tons CH_4
San Diego Gas and Electric	=	1,200,000 kWh	x	0.00728 (lbs/kWh)	÷	2,204.62 lbs/metric ton	=	3.9626 metric tons CH_4
Portland Gas and Electric	=	600,000 kWh	x	0.00359 (lbs/kWh)	÷	2,204.62 lbs/metric ton	=	0.9770 metric tons CH_4
Arizona Public Service	=	800,000 kWh	x	0.00739 (lbs/kWh)	÷	2,204.62 lbs/metric ton	=	2.6816 metric tons CH_4
						Subtotal	=	**12.9047 metric tons CH_4**

Equation 5a	Total Carbon Dioxide (N_2O) Emissions for Electricity Use from Each Facility							
Total Emissions (lbs N_2O)	=	Electricity Use (kWh)	x	Adjusted Emission Factor (lbs N_2O/kWh)	÷	2,204.62 lbs/metric ton		
LADWP	=	1,600,000 kWh	x	0.00402 (lbs/kWh)	÷	2,204.62 lbs/metric ton	=	2.9175 metric tons N_2O
San Diego Gas and Electric	=	1,200,000 kWh	x	0.00402 (lbs/kWh)	÷	2,204.62 lbs/metric ton	=	2.1181metric tons N_2O
Portland Gas and Electric	=	600,000 kWh	x	0.00370 (lbs/kWh)	÷	2,204.62 lbs/metric ton	=	1.0070 metric tons N_2O
Arizona Public Service	=	800,000 kWh	x	0.01674 (lbs/kWh)	÷	2,204.62 lbs/metric ton	=	6.0745 metric tons N_2O
						Subtotal	=	**12.1171 metric tons N_2O**

Step 4: Convert Non-CO_2 Emissions to CO_2e and sum the total.

Equation 5b	Converting Mass Estimates to Carbon Dioxide Equivalent					
Metric Tons of CO_2e	=	Metric Tons of GHG	x	GWP (SAR, 1996)		
Metric Tons of CO_2					=	1,339.02 metric tons CO_2
CH_4 Tons of CO_2e	=	12.9047 metric tons CH_4	x	21 (GWP)	=	271.00 metric tons CO_2e
N_2O Tons of CO_2e	=	12.1171 metric tons N_2O	x	310(GWP)	=	3,756.30 metric tons CO_2e
				Total	=	**5,366.32 metric tons CO_2e**

Chapter 6 Direct Emissions from Mobile Combustion

Ⓐ Ⓑ Ⓒ Ⓓ	Chapter 6 applies to all participant categories operating their own motor vehicles or other forms of transportation.
What you will find in Chapter 6	This chapter provides guidance on calculating your direct emissions from mobile combustion.
Information you will need	You will need information about the types of vehicles your organization operates, where they are registered, and fuel consumption and vehicle miles traveled for each type of vehicle. Fuel consumption data may be obtained from bulk fuel purchases, fuel receipts, or direct measurements of fuel use, such as official logs of vehicle fuel gauges or storage tanks. Sources of annual mileage data could include: odometer readings, or trip manifests that include mileage to destinations.
Cross-References	Be sure to complete Chapter 10 to determine any fugitive emissions you may have from motor vehicle air conditioning units, if applicable. Review Chapter 1 on geographic boundaries in considering which vehicles are based in California, and which are not.

After you have estimated your indirect emissions from electricity consumption, the next source of emissions you should consider is direct emissions from mobile combustion. Mobile sources are non-fixed sources of GHGs such as automobiles, motorcycles, trucks, off-road vehicles, boats, and airplanes. On-road mobile sources include vehicles authorized by the California Department of Motor Vehicles to operate on public roads. All other mobile sources are considered off-road equipment. Material emissions from both on-road and off-road vehicles and equipment must be included in your Emission Report, and can be calculated based on fuel use and/or vehicle miles traveled.

Chapter Overview

Carbon dioxide (CO_2) emissions, the primary GHG emissions from mobile sources, are directly related to the quantity of fuel consumed. Combustion emissions of methane (CH_4) and nitrous oxide (N_2O) are less directly related to fuel composition and depend on the emission control technologies employed in the vehicle. For this reason, their emission factors are typically expressed in terms of mass of compound emitted per distance traveled, and the preferred method of calculating these emissions is based on mileage.

If you are estimating emissions of carbon dioxide and you have only vehicle miles traveled data, please convert that data to fuel consumption based on U.S. EPA's mileage per gallon (mpg) estimates for your vehicles. If you are estimating emissions of methane and nitrous oxide and you have only fuel consumption data, please convert to vehicle miles traveled using the same EPA MPG estimates.

See EPA Website
Fuel Economy Figures
(miles per gallon)
www.fueleconomy.gov

EPA fuel economy figures are available at **http://www.fueleconomy.gov/feg/**. That website provides two figures for your calculation: one for city driving, and one for highway driving.

Unless you have specific information to indicate otherwise, you may assume, as EPA does, that 45% of your vehicles' mileage is highway driving and 55% is city driving (see Equation 6a). If you utilize more than one type of vehicle in your operations, you must calculate the fuel use for each of your vehicle types and sum them together.

Equation 6a **Fuel Use in Motor Vehicles**

$$\text{Fuel Use (gallons)} = \text{Total Mileage (miles)} \div \left[\text{Fuel Economy City (mpg)} \times 55\% + \text{Fuel Economy Highway (mpg)} \times 45\% \right]$$

Calculating Carbon Dioxide (CO_2) Emissions for Mobile Combustion

The method for estimating carbon dioxide emissions applies to both conventional and alternative fuel vehicles as well as off-road vehicles. It is followed by the method for estimating methane and nitrous oxide emissions.

The method for estimating carbon dioxide emissions from mobile sources includes three basic steps:

1. Identify total annual fuel consumption by fuel type;
2. Select the appropriate adjusted CO_2 emission factor from Table 6-1; and
3. Multiply fuel consumed by the emission factor to calculate total CO_2 emissions and convert kilograms to metric tons.

❑ Step 1: Identify the total annual fuel consumption by fuel type.

If you are a fleet operator and you store fuel at any of your facilities, you may use bulk fuel purchases to estimate fuel consumption. You can use Equation 6b to determine your annual fuel consumption. The total annual fuel purchases in Equation 6b should include both fuel purchased for the bulk fueling facility and fuel purchased for the vehicles at other fueling locations.

Equation 6b **Total Annual Fuel Consumption**

$$\text{Total Annual Consumption} = \text{Total Annual Fuel Purchases} + \text{Amount Stored at Beginning of the Year} - \text{Amount Stored at End of Year}$$

Besides bulk storage fuel purchases, additional sources of fuel consumption data may be obtained from collected fuel receipts (for non-bulk purchases) or direct measurements of fuel use, such as official logs of vehicle fuel gauges or storage tanks.

If you only have annual mileage information for the vehicles you own and operate, you may estimate your fuel consumption as follows:

1. identify the vehicle make, model, fuel, and model years for all the vehicles you own and operate;
2. identify the annual mileage by vehicle type; and

3. convert annual mileage to fuel consumption.

Additional sources of annual mileage data could include odometer readings or trip manifests that include mileage to destinations. Vehicle mileage may be converted to fuel consumption using the EPA fuel economy of the specific vehicle models in the fleet. Carbon dioxide emissions are then calculated based on the fuel consumption.

❑ Step 2: Select the appropriate adjusted carbon dioxide emission factor for each fuel from Table 6-1 to calculate carbon dioxide emissions.

See Appendix C Table C-2 Standard CO_2 Emission Factors for Mobile Combustion

To simplify your calculation, Table 6-1, below, provides **adjusted carbon dioxide emission factors** for fuel combusted in motor vehicles and other forms of transport. Each adjusted emission factor is derived from the standard carbon dioxide emission factor (kilograms emitted per MMBtu or per gallon) and an estimated carbon oxidation fraction of 99%. The carbon oxidation fraction is used to reflect the fact that not all of the fuel in a vehicle is fully combusted.

Table 6-1. Adjusted Carbon Dioxide Emission Factors for Transport Fuels

Fuel	Carbon Dioxide Emission Factor	
	kg CO_2/MMBtu	kg CO_2/gallon
Natural Gas	52.785	NA
Petroleum		
Aviation Gasoline	68.488	8.237
Distillate Fuel (Diesel Fuel)	72.419	10.049
Jet Fuel, Kerosene	70.171	9.474
Jet Fuel, Naphtha	72.438	9.237
Kerosene	71.587	9.672
Liquefied Petroleum Gas (LPG)	61.677	5.891
Reformulated Motor Gasoline	NA	NA
Motor Gasoline	70.201	8.781
Residual Fuel	78.012	11.672
Propane	NA	5.672
Butane	NA	6.487
Methanol (neat)	NA	4.069

Note: Emission factors are based on complete combustion and high heating value (HHV).

Source: California Energy Commission, *Inventory of California Greenhouse Gas Emissions and Sinks: 1990-1999* (Draft: December 2001), Tables 2-5 & 2-6, page 33; Energy Information Administration, *Emissions of Greenhouse Gases in the United States 2000*, (2001), Table B1, page 140, see **http://www.eia.doe.gov/oiaf/1605/ggrpt**; propane and butane emission factors and fractions oxidized from U.S. Environmental Protection Agency, *Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition*, see **http://www.epa.gov/ttn/chief/ap42/index.html**. Methanol emission factor is calculated from the properties of the pure compounds; the fraction oxidized is assumed to be the same as for other liquid fuel.

❑ Step 3: Multiply fuel consumed by the emission factor to calculate total CO_2 emissions and convert to metric tons.

Equation 6c	Total CO_2 Emissions from Mobile Combustion				
Total Emissions (metric tons)	=	Fuel Consumed (gallons)	x	Emission Factor (kg CO_2/gallon)	x 0.0001 metric tons/kg

Calculating Methane (CH_4) and Nitrous Oxide (N_2O) Emissions for Mobile Combustion

The method for estimating emissions of methane and nitrous oxide from mobile sources involves six steps:

1. Identify the vehicle types, fuel, and model years of all the vehicles you own and operate;
2. Identify the annual mileage by vehicle type;
3. Select the appropriate emission factor for each vehicle and fuel type (using Table 6-2);
4. Calculate each vehicle type CH_4 and N_2O emissions and convert grams to metric tons;
5. Sum the emissions over each vehicle and fuel type; and
6. Convert CH_4 and N_2O Emissions to CO_2e and sum the subtotals.

There is insufficient data available at present to provide emission factors for emissions of methane and nitrous oxide from alternative fuel vehicles, and thus this method should only be used to estimate the emissions from conventional vehicles for which emission factors are provided.

❑ Step 1: Identify the vehicle types, fuel, and model years of all the vehicles you own and operate.

Vehicle types and emission factors by model year are shown in Table 6-2 on the next page, for passenger cars, light-duty trucks, heavy-duty trucks, and motorcycles.

❑ Step 2: Identify the annual mileage by vehicle type.

If you do not have mileage but you do have fuel consumption by vehicle type model and year you can estimate the vehicle miles traveled using the EPA fuel economy of the specific vehicle models in the fleet. You can then calculate methane and nitrous oxide emissions based on vehicle miles traveled, using Equation 6d, below. If you have only bulk fuel purchase data, you should allocate consumption across vehicle types and model years provided in Table 6-2.

Equation 6d	Fuel Use Per Year		
Total Fuel Use (gallons)	= Miles traveled (mi.)	÷ Fuel economy (miles/gallon)	

EPA fuel economy figures are available at **http://www.fueleconomy.gov/feg/**. Two figures are provided: one for city driving, and one for highway driving. You may assume, as EPA does, that 45% of your vehicles' mileage is highway driving and 55% is city driving unless you have specific information to indicate otherwise (see Equation 6e).

See EPA Website
Fuel Economy Figures (miles per gallon)
www.fueleconomy.gov

Equation 6e	Annual Mileage								
Total Mileage (mi.)	= Fuel use (gallons)	x [	Fuel Economy City (mpg)	x 55%	+	Fuel Economy Highway (mpg)	x 45%	]	

❑ Step 3: Select the appropriate emission factor from Table 6-2 for each vehicle and fuel type.

Table 6-2. Mobile Source Methane and Nitrous Oxide Emission Factors by Vehicle and Fuel Type in g/mile

Vehicle Types/Model Years	CH_4 (g/mile)	N_2O (g/mile)
Gasoline Passenger Cars		
Model Year 1966-1972	0.22	0.02
Model Year 1973-1974	0.19	0.02
Model Year 1975-1979	0.11	0.05
Model Year 1980-1983	0.07	0.08
Model Year 1984-1991	0.06	0.08
Model Year 1992	0.06	0.07
Model Year 1993	0.05	0.05
Model Year 1994 - present	0.05	0.04
Diesel Passenger Cars		
All Model Years	0.02	0.02
Gasoline Light Duty Truck (<5750 GVWR*)		
Model Year 1966-1972	0.22	0.02
Model Year 1973-1974	0.23	0.02
Model Year 1975-1979	0.14	0.07
Model Year 1980-1983	0.12	0.13
Model Year 1984-1991	0.11	0.14
Model Year 1992	0.09	0.11
Model Year 1993	0.07	0.08
Model Year 1994 - present	0.06	0.06
Diesel Light Duty Trucks		
All Model Years	0.02	0.03
Gasoline Heavy-Duty Vehicle (>5751 GVWR)		
Model Year 1981 and older	0.43	0.04
Model Year 1982-1984	0.42	0.05
Model Year 1985-1986	0.20	0.05
Model Year 1987	0.18	0.09
Model Year 1988-1989	0.17	0.09
Model Year 1990-2003	0.16	0.13
Diesel Heavy Duty Trucks		
Model Year 1966-1982	0.10	0.05
Model Year 1983-1995	0.08	0.05
Model Year 1996-1999	0.06	0.05
Motorcycles		
Model Year 1966-1995	0.42	0.01
Model Year 1996-1999	0.21	0.01

*GVWR = Gross Vehicle Weight Rating

Note: Emission factors are based on complete combustion and high heating value (HHV).

Source: Derived from California Energy Commissions, *Inventory of California Greenhouse Gas Emissions and Sinks: 1990-1999* (Draft: December 2001), Table 2-20, page 46.

❑ Step 4: Calculate each vehicle type CH_4 and N_2O emissions and convert to metric tons.

Use Equation 6f to calculate total emissions for CH_4 and N_20 for each vehicle type. Note, if non-CO_2 gases are de minimis after they are converted to CO_2e and metric tons, you do not need to report them to the Registry.

Equation 6f	Total CH_4 or N_20 Emissions from Mobile Combustion					
Total Emissions (metric tons)	=	Adjusted Emission Factor (g/mi)	x	Annual Mileage (mi)	x	0.000001 metric tons/g

❑ Step 5: Sum the emissions for each vehicle and fuel type.

The emissions calculated using Equation 6f must be done for each vehicle and fuel type. The emissions for each vehicle and fuel combination should be added together to obtain the total emissions from all mobile sources.

❑ Step 6: Convert CH_4 and N_2O Emissions to CO_2e and sum the subtotals.

See This Chapter
Table 5-2
Global Warming Potential Factors

Use the IPCC Second Assessment Report (SAR) global warming potential factors from Table 5-2 in this chapter to convert methane and nitrous oxide to carbon dioxide equivalent. (See Equation 5b in this chapter.)

Total CO_2e Emissions from Mobile Combustion

One you have completed the steps for estimating carbon dioxide, methane, and nitrous oxide emissions, and converted methane and nitrous oxide to carbon dioxide equivalents, you can determine your total CO_2e emissions from mobile combustion.

Example: Direct Emissions from Mobile Combustion

GOFAST Vehicle Rental Agency

GOFAST Vehicle Rental is an independent vehicle renting company located in California, with a fleet of 200 model year 2000 passenger cars, 25 model year 2000 light duty trucks, and 2 model year 1998 heavy duty diesel powered trucks. GOFAST is a Category A organization, and typically purchases its fuel in bulk. Last year, the company purchased 235,000 gallons of motor gasoline and 5,000 gallons of diesel fuel. GOFAST began the year with 20,000 gallons of motor gasoline in stock and ended with 10,000 gallons of motor gasoline in stock. The company also began the year with 500 gallons of diesel fuel in stock and ended with 1,000 gallons of diesel fuel in stock.

Carbon Dioxide (CO_2) Emissions Calculation

Step 1: Identify the total annual fuel consumption by fuel type.

Equation 6a	Total Annual Fuel Consumption by Fuel Type						
Total Fuel Consumption	=	Total Annual Fuel Purchases	+	Amount Stored at Beginning of the Year	–	Amount Stored at End of Year	
Total Gasoline Consumption	=	235,000 gallons	+	20,000 gallons	–	10,000 gallons	= 245,000 gallons
Total Diesel Consumption	=	5,000 gallons	+	500 gallons	–	1,000 gallons	= 4,500 gallons

Step 2: Select the appropriate adjusted carbon dioxide emission factor for each fuel from Table 6-1 to calculate carbon dioxide emissions.

The adjusted CO_2 emission factor for motor gasoline is 8.78 kilograms per gallon and for diesel fuel is 11.67 kilograms per gallon.

Adjusted Carbon Dioxide Emission Factors for Transport Fuels		
	Carbon Dioxide Emission Factor	
Fuel	kg CO_2/MMBtu	kg CO_2/gallon
Petroleum		
Motor Gasoline	70.20	8.78
Diesel Fuel	72.419	10.049

Step 3: Multiply fuel consumed by the emission factor to calculate total CO_2 emissions.

Equation 6c	Carbon Dioxide (CO_2) Emissions Contribution of Each Fuel							
Total Emissions (kg)	=	Adjusted Emission Factor (kg CO_2/gallon)	x	Fuel Consumed (gallons)	x	0.001 metric tons/kg		
CO_2 from Motor Gasoline	=	8.87 kg/gallon	x	245,000 gallons	x	0.001 metric tons/kg	=	2,173.15 metric tons CO_2
CO_2 from Diesel Fuel	=	10.049 kg/gallon	x	4,500 gallons	x	0.001 metric tons/kg	=	45.221 metric tons CO_2
						Total	=	**2,218.371 metric tons CO_2**

Methane (CH_4) and Nitrous Oxide (N_2O) Emissions Calculation

Step 1: Identify the vehicle types, fuel, and model years of all the vehicles you own and operate.

Table 6-3. Vehicle Type, Fuel, and Model Year

Vehicle Type	Fuel	Model Year
Passenger Cars	Motor Gasoline	1998 through 2002
Light Duty Trucks	Motor Gasoline	1998 through 2002
Heavy Duty Trucks	Diesel	1998

Step 2: Identify the annual mileage by vehicle type.

First, GOFAST will have to allocate gross fuel consumption (gallons consumed per year) by vehicle type and model year. For the purposes of this example, it is assumed that GOFAST is able to calculate total fuel consumption provided in Table 6-4 based on fuel purchase receipts to arrive at total gallons of fuel consumed for each vehicle type.

Table 6-4. Gross Fuel Consumption by Vehicle Type

Vehicle Type	Fuel	Model Year	Fuel Consumption
Passenger Cars	Motor Gasoline	2000	119,000 gallons
Light Duty Trucks	Motor Gasoline	2000	21,000 gallons
Heavy Duty Trucks	Diesel	1998	10,000 gallons

Next, GOFAST must determine vehicle miles traveled using EPA mpg estimates.

Equation 6e	Annual Vehicle Miles Traveled												
Total Mileage (mi.)	=	Fuel use (gallons)	x	[	Fuel Economy City (mpg)	x	55%	+	Fuel Economy Highway (mpg)	x	45%	]	
Total Mileage (mi.)	=	119,000 gallons	x	[	20 mpg	x	55%	+	25 mpg	x	45%	]	= **2,647,750 miles**
Total Mileage (mi.)	=	21,000 gallons	x	[	15 mpg	x	55%	+	20 mpg	x	45%	]	= **362,250 miles**
Total Mileage (mi.)	=	10,000 gallons	x	[	8 mpg	x	55%	+	10 mpg	x	45%	]	= **89,000 miles**

Step 3: Select the appropriate emission factor from Table 6-2 for each vehicle and fuel type.

Table 6-5. Emission Factors for Each Fuel and Vehicle Type

Vehicle Type	Fuel	Model Year	Methane (g/mi)	Nitrous Oxide (g/mi)
Passenger Cars	Motor Gasoline	2000	0.05	0.04
Light Duty Trucks	Motor Gasoline	2000	0.06	0.06
Heavy Duty Trucks	Diesel	1998	0.06	0.05

Step 4: Calculate each vehicle type CH_4 and N_2O emissions and convert to metric tons.

Equation 6f	Passenger Cars: Total CH_4 and N_2O Emissions							
Total Emissions (metric tons)	=	Adjusted Emission Factor (g/mi.)	x	Annual Mileage (mi)	x	0.000001 metric tons/g		
CH_4 Emissions (metric tons)	=	0.05 g/mi	x	2,647,750 mi	x	0.000001 metric tons/g	=	**.1323 metric tons CH_4**
N_2O Emissions (metric tons)	=	0.04 g/mi	x	2,647,750 mi	x	0.000001 metric tons/g	=	**.106 metric tons N_2O**

Equation 6f	Light-Duty Trucks: Total CH_4 and N_2O Emissions							
Total Emissions (metric tons)	=	Adjusted Emission Factor (g/mi.)	x	Annual Mileage (mi)	x	0.000001 metric tons/g		
CH_4 Emissions (metric tons)	=	0.06 g/mi	x	362,250 mi	x	0.000001 metric tons/g	=	**.0217 metric tons CH_4**
N_2O Emissions (metric tons)	=	0.06 g/mi	x	362,250 mi	x	0.000001 metric tons/g	=	**.0217 metric tons N_2O**

Equation 6f	Heavy-Duty Trucks: Total CH_4 and N_2O Emissions							
Total Emissions (metric tons)	=	Adjusted Emission Factor (g/mi.)	x	Annual Mileage (mi)	x	0.000001 metric tons/g		
CH_4 Emissions (metric tons)	=	0.06 g/mi	x	89,000 mi	x	0.000001 metric tons/g	=	**.0053 metric tons CH_4**
N_2O Emissions (metric tons)	=	0.05 g/mi	x	89,000 mi	x	0.000001 metric tons/g	=	**.0045 metric tons N_2O**

Step 5: Sum the emissions for each vehicle and fuel type.

Table 6-6. Total Carbon Dioxide Equivalent from Mobile Sources

Vehicle Type	Fuel	Model Year	CH_4 (metric tons)	N_2O (metric tons)
Passenger Cars	Motor Gasoline	2000	.1323	.106
Light Duty Trucks	Motor Gasoline	2000	.0217	.0217
Heavy Duty Trucks	Diesel	1998	.0053	.0045
		Total	**.1593**	**.1322**

Step 6: Convert CH_4 and N_2O Emissions to CO_2e and sum the subtotals.

Equation 5b	Convert to Carbon Dioxide Equivalent				
Total CO_2e (metric tons)	=	Total Emissions (metric tons)	x	GWP factor	
Total CO_2e (metric tons)	=	.1593 metric tons CH_4	x	21 (GWP)	= **3.345 metric tons CO_2e**
Total CO_2e (metric tons)	=	.1322 metric tons N_2O	x	310 (GWP)	= **40.982 metric tons CO_2e**

Total CO_2e Emissions from Mobile Combustion

Table 6-7. Total CO_2e Emissions from Mobile Combustion

GHG	metric tons CO_2e
CO_2	2,218.371
CH_4	3.345
N_2O	40.982
Total	**2,262.698 metric tons CO_2e**

* Note: GOFAST's methane and nitrous oxide emissions are both de minimis and would not need to be reported to the Registry.

Chapter 7 Direct Emissions from Stationary Combustion

B C D	Chapter 7 applies to all participant categories except Category A.
What you will find in Chapter 7	This chapter provides guidance on determining direct emissions from stationary combustion, such as through power generation, manufacturing, or other industrial activities involving the combustion of fossil or biomass fuels.
Information you will need	You will need information about the type of fuels consumed by your organization, and how much was combusted in the reporting year.
Cross-References	If your organization produces electricity or heat from co-generation, imported stream, and district heating and cooling, you should refer to Chapter 8 to determine what emissions to report using this chapter and what to report using Chapter 8. In turn, this chapter will assist you in understanding the emissions resulting from co-generation discussed in Chapter 8.

Chapter Overview

Now that you have completed estimates of indirect emissions from electricity consumption and direct emissions from mobile sources, you should calculate your direct emissions from stationary combustion. Stationary combustion sources are non-mobile sources emitting GHGs from fuel combustion. Typical large stationary sources include power plants, refineries, and manufacturing facilities. Smaller stationary sources include commercial and residential furnaces.

Emission Factors for Stationary Sources

Default emission factors are provided in Tables 7-2, 7-3, and 7-4. If your company has emission factors that are more accurate for the fuels and combustion devices that your organization employs, you may use these factors. If you decide not to use the Registry-approved emission factors, you will need to demonstrate to your certifier that the use of the alternative emission factors results in a more accurate measurement of your emissions.

The following is a list of Registry-approved emissions factors for your consideration:

- U.S. EPA, *Compilation of Air Pollutant Emission Factors AP-42*, **http://www.epa.gov/ttn/chief/ap42**;
- U.S. EPA Emissions Inventory Improvement Program (EIIP) *Introduction to Estimating Greenhouse Gas Emissions: Volume VII* (EIIP, 1999), **http://www.epa.gov/ttn/chief/eiip/techreport/volume08/index.html**;

- IPCC *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories, Greenhouse Gas Inventories Reference Manual* (IPCC, 1996), **http://www.ipcc-nggip.iges.or.jp/public/gl/invs1.htm**; and

- UK Department for Environment, Food, and Rural Affairs, *Guidelines for the Measurement and Reporting of Emissions in the UK Emissions Trading Scheme* (DEFRA, 2001b), **http://www.defra.gov.uk/environment/climatechange/trading**.

Estimating Emissions Based on Higher Heating Value

To estimate stationary combustion emissions, the Protocol utilizes GHG emission factors that are based on the "higher" heating value (HHV) (or "gross" heating value (GHV)) for combusted fossil fuels. When hydrocarbons are combusted, heat, water vapor, and carbon dioxide are emitted, along with trace levels of other GHGs like CH_4 and N_2O. In the United States, the heat resulting from combustion is generally measured as the heat associated with production of water vapor and carbon dioxide. HHV is used to measure heat content and, therefore, total GHG emissions resulting from the combustion process.[7] This is also the approach employed by the U.S. Energy Information Administration (EIA). However, it should be noted that the "lower" heating value (LHV) is typically used internationally.[8]

Using Continuous Emissions Monitoring System (CEMS) Data

Typically, you will be able to calculate your GHG emissions from stationary combustion using the process outlined on the next page. If you are a large electric generator covered by the Acid Rain Program and required to use a continuous emissions monitoring system (CEMS), you may report using that CEMS data.

Stationary Emissions from Agricultural Residue Burning

While this Protocol does not include specific guidance on estimating emissions from agricultural residue burning, some useful information is provided in the CEC's *Guidance to the California Climate Action Registry: General Reporting Protocol*, P500-02-005F (June 2002), in Appendix B. (See **www.climateregistry.org** for a copy of the report.)

See This Chapter
Box 7-1
Reporting CEMS Data

[7] U.S. Energy Information Administration, *Emissions of Greenhouse Gases in the United States* (2000).

[8] To result in the same number for estimated carbon emissions using LHVs, the emission factors would be 5% to 10% larger because Btu content of the fuel would be 5% to 10% lower. This process is not perfect, however, and is sometimes a source of discrepancy. See Organization for Economic Cooperation and Development, Estimation of Greenhouse Gas Emissions and Sinks, Final Report (Paris, France, August 1991), pp. 2-12-2-15.

Box 7-1. Reporting Carbon Dioxide (CO_2) Measurements from Electricity-Generating Units Covered by U.S. EPA's Acid Rain Program

Under the Acid Rain program, affected units are required to install continuous emissions monitoring systems (CEMS) for emissions of sulfur dioxide (SO_2) and/or nitrogen oxides (NO_X). These affected units are also required to report carbon dioxide (CO_2) emissions to the U.S. EPA. While EPA regulations do not require that reported carbon dioxide emissions be based on CEMS measurements, in many cases the unit operators do use CEMS to report carbon dioxide emissions.

Participants who operate CEMS under the Acid Rain Program and use them to measure carbon dioxide emissions may use these results for reporting to the Registry instead of reporting emissions based on fuel consumption. Participants who wish to use CEMS for reporting carbon dioxide emissions should note the following:

- Since CEMS typically do not analyze for methane and nitrous oxide in the flue gas, these emissions will still need to be estimated based on fuel use when they are being reported to the Registry;
- Once you begin to report carbon dioxide emissions based on CEMS results, CEMS will have to be used consistently for the affected units over the entire reporting period; and
- If changes to the CEMS methodology for calculating emissions are made (for example, to eliminate bias in CEMS measurements), these changes will have to be made to the entire reporting period to eliminate changes in the reported emissions that occur solely as a result of changes in the calculation methodology.

Calculating Emissions from Stationary Combustion

Emissions estimation for stationary combustion involves the following process:

1. Identify all types of fuel directly combusted in your operations;
2. Identify annual consumption of each fuel;
3. Select the appropriate adjusted emission factor for each fuel;
4. Calculate each fuel's carbon dioxide emissions and convert to metric tons;
5. Calculate each fuel's methane and nitrous oxide emissions, if any, and convert to metric tons; and
6. Convert CH_4 and N_2O emissions to CO_2e and sum all subtotals.

❑ Step 1: Identify all types of fuel directly combusted in your operations.

Fuel types can include, for example: coal, residual fuel oil, distillate fuel (diesel), liquefied petroleum gas (LPG), and natural gas.

❑ Step 2: Determine annual consumption of each fuel.

This can be done by recording fuel purchase and sales invoices measuring any stock change (measured in million Btus or gallons) using Equation 7a.

Equation 7a	Annual Consumption of Fuels							
Annual Consumption (MMBtu or gallons)	=	Total Annual Fuel Purchases	–	Total Annual Fuel Sales	+	Amount Stored at Beginning of Year	–	Amount Stored at Year End

If your fuel consumption is not available in million Btus or in gallons, you can convert it using the conversion factors below.

See Appendix B
Common Conversion Factors

Table 7-1. Conversion Factors

Unit	Multiplied by	Equals
Barrels	42	Gallons
Therms of Natural Gas	0.1	Million Btus
Thousand Cubic Feet of Natural Gas	1.03	Million Btus
Metric Tons of Coal, Electric Utility	22.488	Million Btus
Metric Tons of Coal, Industrial Coke	30.232	Million Btus
Metric Tons of Coal, Other Industry	24.790	Million Btus
Metric Tons of Coal, Residential & Commercial	26.323	Million Btus

Source for coal data: Energy Information Administration, *Annual Energy Review 2000* (2002), Table A5, see **http://www.eia.doe.gov/aer/txt/tab1305.htm**.

❑ Step 3: Select the appropriate adjusted emission factor for each fuel from Tables 7-2, 7-3, and 7-4.

Each fuel type has specific emission factors that measure the amount of carbon dioxide, methane, or nitrous oxide emitted per unit of fuel consumed (either in kilograms per MMBtu of fuel, or kilograms per gallon of fuel). Carbon dioxide emission factors depend almost completely on the carbon content of the fuel. Methane and nitrous oxide emission factors also depend on the type of combustion device and the combustion conditions.

Carbon Dioxide. Table 7-2 provides adjusted carbon dioxide emission factors for the most common fuel types in kilograms of CO_2 per million Btu (MMBtu) and in kilograms of CO_2 per gallon for liquid fuels. If you burn a fuel that is not listed in Table 7-2, such as refinery fuel gas, you should estimate an emission factor based on the specific properties of the fuel and document those properties. Table 7-2 provides emission factors for coal consumed for both California and U.S., except for coking and utility coals, which are not consumed in California.

Note, the adjusted carbon dioxide emission factors provided in Table 7-2 already incorporate a factor for the fraction of carbon oxidized. The ***carbon oxidation fraction*** reflects the fact that slightly less than 100% of the fuel consumed is completely combusted. For the most direct calculation, use Table 7-2. (Note, Table C-4 in Appendix C provides standard carbon dioxide emission factors and figures for the fraction of carbon oxidized separately for each fuel used in stationary combustion.)

Table 7-2. Adjusted Carbon Dioxide Emission Factors for Stationary Combustion

Fuel	Carbon Dioxide Emission Factors		
	kg CO_2/MMBtu (California)	kg CO_2/MMBtu (U.S.)	kg CO_2/gallon
Coal			
Residential Coal	91.84	94.38	NA
Commercial Coal	91.84	94.38	NA
Industrial Coking Coal		92.78	NA
Industrial Other Coal	92.07	93.04	NA
Utility Coal		93.51	NA
Natural Gas		52.78	NA
Petroleum			
Distillate Fuel		72.42	10.05
Kerosene		71.59	9.67
Liquefied Petroleum Gas (LPG)		61.68	5.89
Motor Gasoline (Conventional)		70.20	8.78
Reformulated Gasoline		69.73	8.55
Residual Fuel		78.01	11.67
Propane		NA	5.67
Butane		NA	6.49
Methanol (neat)		NA	4.07
Crude Oil		73.44	10.14
Still Gas		63.88	NA

Note: Emission factors are based on complete combustion and reflect higher heating value (HHV). Emission factors for coking and utility coals are not given for California because they are not consumed in the state.

Sources: All emission factors except propane, butane, and reformulated gasoline are derived from: California Energy Commission, *Inventory of California Greenhouse Gas Emissions and Sinks: 1990-1999* DRAFT (December 2001), Tables 2-5 & 2-6, pages 33-34; and Energy Information Administration, *Emissions of Greenhouse Gases in the United States 2000* (2001), Table B1, page 140, see **http://www.eia.doe.gov/oiaf/1605/ggrpt**. Propane and butane emission factors and fractions oxidized from Propane and Butane emission factors are derived from U.S. Environmental Protection Agency, *Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition*, see **http://www.epa.gov/ttn/chief/ap42/index.html**. Methanol emission factor is calculated from the properties of the pure compounds; the fraction oxidized is assumed to be the same as for other liquid fuels. Reformulated gasoline (summer) was derived from information provided by the U.S. Energy Information Administration (August 19, 2002).

Methane and Nitrous Oxide. Table 7-3, below, presents methane (CH_4) and nitrous oxide (N_2O) emission factors by activity sector and fuel type. For petroleum products, emission factors for methane and nitrous oxide are provided in kilograms per gallon consumed.

Table 7-3 Methane (CH_4) and Nitrous Oxide (N_2O) Emission Factors for Stationary Combustion by Sector and Fuel Type

Sector	Fuel	kg CH_4/MMBtu	kg N_2O/MMBtu
Electric Utilities	Coal	0.0011	0.0016
	Petroleum	0.0033	0.0007
	Natural Gas	0.0012	0.0001
	Wood	0.0351	0.0047
Industrial	Coal	0.0111	0.0016
	Petroleum	0.0022	0.0007
	Natural Gas	0.0059	0.0001
	Wood	0.0351	0.0047
Commercial/Institutional	Coal	0.0111	0.0016
	Petroleum	0.0111	0.0007
	Natural Gas	0.0059	0.0001
	Wood	0.3514	0.0047
Residential	Coal	0.3329	0.0016
	Petroleum	0.0111	0.0007
	Natural Gas	0.0059	0.0001
	Wood	0.3514	0.0047

Note: All emission factors have been converted to higher heating value (HHV), assuming LHV is 95% of HHV for coal and petroleum and is 90% of HHV for natural gas and wood.

Sources: Emission factors are derived from: U.S. Environmental Protection Agency, *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2000* (2002), Table C-2, page C-2. EPA obtained original emission factors from the Intergovernmental Panel on Climate Change, *Revised IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual* (1996), Tables 1-15 through 1-19, pages 1.53-1.57.

For petroleum products, methane (CH_4) and nitrous oxide (N_2O) emission factors are also shown in kilograms per gallon in Table 7-4.

Table 7-4 Methane (CH_4) and Nitrous Oxide (N_2O) Emission Factors for Petroleum Fuels by Sector and Fuel Type (kg/gallon)

Sector	Fuel	kg CH_4/gallon	kg N_2O/gallon
Electric Utilities	Distillate Fuel	0.0004	0.0001
	Liquefied Petroleum Gas (LPG)	0.0003	0.0001
	Residual Fuel	0.0004	0.0001
Industrial	Distillate Fuel	0.0003	0.0001
	Kerosene	0.0003	0.0001
	Liquefied Petroleum Gas (LPG)	0.0002	0.0001
	Residual Fuel	0.0003	0.0001
Commercial/Institutional	Distillate Fuel	0.0014	0.0001
	Kerosene	0.0014	0.0001
	Liquefied Petroleum Gas (LPG)	0.0010	0.0001
	Motor Gasoline	0.0013	0.0001
	Residual Fuel	0.0015	0.0001
Residential	Distillate Fuel	0.0014	0.0001
	Kerosene	0.0014	0.0001
	Liquefied Petroleum Gas (LPG)	0.0010	0.0001
	Motor Gasoline	0.0013	0.0001
	Propane	9.1×10^{-5}	4.1×10^{-4}
	Butane	9.1×10^{-5}	4.1×10^{-4}

Note: Emission factors have been converted to higher heating value (HHV), assuming LHV is 95% of HHV for all petroleum fuels. Propane and butane emission factors have not been converted, as they reflected HHV in the original EPA source.

Sources: "Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2000" Annex C Table C-2: CH_4 and N_2O Emission Factors by Fuel Type and Sector and Annex W Table W-2: Conversion Factors to Energy Units (Heat Equivalents) (EPA, 2002. U.S. Environmental Protection Agency, Washington, D.C. April. EPA-236-R-02-003).

❑ Step 4: Calculate each fuel's carbon dioxide emissions and convert to metric tons.

Use Equation 7b if the fuel consumption is expressed in MMBtu. Use equation 7c if fuel is expressed in gallons.

Equation 7b	Total CO_2 Emissions (Fuel Consumption is in MMBtu)					
Total Emissions (metric tons)	=	Adjusted Emission Factor (kg CO_2/MMBtu)	x	Fuel Consumed (MMBtu)	x	0.001 metric tons/kg

Equation 7c	Total CO_2 Emissions (Fuel Consumption is in Gallons)					
Total Emissions (metric tons)	=	Adjusted Emission Factor (kg CO_2/gallon)	x	Fuel Consumed (gallon)	x	0.001 metric tons/kg

❑ Step 5: If you are reporting methane (CH_4) and nitrous oxide (N_2O) emissions, calculate each fuel's methane and nitrous oxide emissions and convert to metric tons.

Use Equation 7d if the fuel consumption is expressed in MMBtu. Use equation 7e if it is expressed in gallons. Note, if non-CO2 gases are de minimis after they are converted to CO2e and metric tons, you do not need to report them to the Registry.

Equation 7d	Total CH_4 or N_2O Emissions (Fuel Consumption is in MMBtu)					
Total Emissions (metric tons)	=	Adjusted Emission Factor (kg CH_4 or N_2O /MMBtu)	x	Fuel Consumed (MMBtu)	x	0.001 metric tons/kg

Equation 7e	Total CH_4 or N_2O Emissions (Fuel Consumption is in Gallons)					
Total Emissions (metric tons)	=	Adjusted Emission Factor (kg CH_4 or N_2O / gallon)	x	Fuel Consumed (gallon)	x	0.001 metric tons/kg

❑ Step 6: Convert CH_4 and N_2O Emissions to CO_2e and sum all subtotals.

See Chapter 5
Table 5-2
Global Warming Potential Factors

Use the IPCC Second Assessment Report (SAR) global warming potential factors from Table 5-2 in Chapter 5 to convert methane and nitrous oxide to carbon dioxide equivalent. (See Equation 5b in Chapter 5.)

Example: Calculating Direct Emissions from Stationary Combustion

B

F and M Power Corporation

F&M is a Category B organization serving as an independent power producer with headquarters in California. It has two 100 mW generating units, one in California that burns natural gas and one at a mine mouth in Wyoming that burns coal. F&M also has a commercial office building in California that is heated with distillate fuel.

Step 1: Identify all types of fuel directly combusted in your operations.

Table 7-5. Fuel Type, Sector, and Location

Fuel	Sector	Location
Natural Gas	Electric Power	California
Coal	Electric Power	Wyoming
Diesel	Commercial	California

Step 2: Determine annual consumption of each fuel.

F&M measures heat input (MMBtus of fuel used) into its power plants, and purchases its heating fuel for commercial use in bulk by the barrel. Last year it consumed 7,884,000 MMBtus of natural gas and 9,460,000 MMBtus of coal. It also purchased 265 barrels of

distillate fuel for heating and sold 15 barrels. F&M began the year with 12 barrels in storage and ended the year with 24 barrels in storage. Using Equation 7a, F&M determined distillate fuel consumption. The result, 238 barrels can be converted to gallons by multiplying by 42. See Table 7-1.

Equation 7a	Annual Consumption of Fuels									
Annual Consumption (MMBtu or gallons)	=	Total Annual Fuel Purchases	–	Total Annual Fuel Sales	+	Amount Stored at Beginning of Year	–	Amount Stored at Year End		
Annual Consumption of Distillate Fuel	=	265 barrels	–	15 barrels	+	12 barrels	–	24 barrels	=	238 barrels consumed
						238 barrels consumed	x	42 gallons/ barrel	=	9,996 gallons

Step 3: Select the appropriate emission factors for each fuel from Tables 7-2, 7-3, and 7-4.

Table 7-6. Emission Factors by Fuel Type, Sector, and Location

Fuel	Sector	Location	kg CO_2 per		kg CH_4 per		kg N_2O per	
			MMBtu	gallon	MMBtu	gallon	MMBtu	gallon
Natural Gas	Electric Power	California	52.78	–	0.0012	–	0.0001	–
Coal	Electric Power	Wyoming	93.51	–	0.0011	–	0.0016	–
Distillate Fuel	Commercial	California	–	10.05	–	0.0014	–	0.0001

Step 4: Calculate each fuel's carbon dioxide emissions

Use Equation 7b if the fuel consumption is expressed in MMBtu, and Equation 7c if it is expressed in gallons.

Equation 7b	Carbon Dioxide (CO_2) Emissions from Natural Gas (Fuel Consumption is in MMBtu)							
Total Emissions (metric tons)	=	Adjusted Emission Factor (kg CO_2/MMBtu)	x	Fuel Consumed (MMBtu)	x	0.001 metric tons/kg		
Total Emissions (metric tons)	=	52.78 kg CO_2/MMBtu	x	7,884,000 MMBtu	x	0.001 metric tons/kg	=	416,117.5 metric tons CO_2

Equation 7b	Carbon Dioxide (CO_2) Emissions from Coal (Fuel Consumption is in MMBtu)							
Total Emissions (metric tons)	=	Adjusted Emission Factor (kg CO_2/MMBtu)	x	Fuel Consumed (MMBtu)	x	0.001 metric tons/kg		
Total Emissions (metric tons)	=	93.51 kg CO_2/MMBtu	x	9,460,000 MMBtu	x	0.001 metric tons/kg	=	884,604.6 metric tons CO_2

Equation 7c	Total CO_2 Emissions from Distillate Fuel (Fuel Consumption is in Gallons)						
Total Emissions (metric tons)	=	Adjusted Emission Factor (kg CO_2/gallon)	x	Fuel Consumed (gallons)	x	0.001 metric tons/kg	
Total Emissions (metric tons)	=	10.05 kg CO_2/gallon	x	9,996 gallons	x	0.001 metric tons/kg	= 100.5 metric tons CO_2

Total CO_2 from All Sources = **1,300,822.6 metric tons CO_2**

Step 5: Calculate each fuel's methane and nitrous oxide emissions.

Equation 7b	Methane (CH_4) Emissions from Natural Gas (Fuel Consumption is in MMBtu)						
Total Emissions (metric tons)	=	Adjusted Emission Factor (kg CH_4/MMBtu)	x	Fuel Consumed (MMBtu)	x	0.001 metric tons/kg	
Total Emissions (metric tons)	=	0.0012 kg CH_4/MMBtu	x	7,884,000 MMBtu	x	0.001 metric tons/kg	= 9.460 metric tons CH_4

Equation 7b	Methane (CH_4) Emissions from Coal (Fuel Consumption is in MMBtu)						
Total Emissions (metric tons)	=	Adjusted Emission Factor (kg CH_4/MMBtu)	x	Fuel Consumed (MMBtu)	x	0.001 metric tons/kg	
Total Emissions (metric tons)	=	0.0011 kg CH_4/MMBtu	x	9,460,000 MMBtu	x	0.001 metric tons/kg	= 10.406 metric tons CH_4

Equation 7c	Methane (CH_4) Emissions from Distillate Fuel (Fuel Consumption is in Gallons)						
Total Emissions (metric tons)	=	Adjusted Emission Factor (kg CH_4/gallon)	x	Fuel Consumed (gallons)	x	0.001 metric tons/kg	
Total Emissions (metric tons)	=	0.0014 kg CH_4/gallon	x	9,996 gallons	x	0.001 metric tons/kg	= 0.014 metric tons CH_4

Total CH_4 from All Sources = **19.88 metric tons CH_4**

Equation 7b	Nitrous Oxide (N_2O) Emissions from Natural Gas (Fuel Consumption is in MMBtu)							
Total Emissions (metric tons)	=	Adjusted Emission Factor (kg N_2O/MMBtu)	x	Fuel Consumed (MMBtu)	x	0.001 metric tons/kg		
Total Emissions (metric tons)	=	0.0001 kg N_2O/MMBtu	x	7,884,000 MMBtu	x	0.001 metric tons/kg	=	0.7884 metric tons N_2O

Equation 7b	Nitrous Oxide (N_2O) Emissions from Coal (Fuel Consumption is in MMBtu)							
Total Emissions (metric tons)	=	Adjusted Emission Factor (kg N_2O/MMBtu)	x	Fuel Consumed (MMBtu)	x	0.001 metric tons/kg		
Total Emissions (metric tons)	=	0.0016 kg N_2O/MMBtu	x	9,460,000 MMBtu	x	0.001 metric tons/kg	=	15.136 metric tons N_2O

Equation 7c	Nitrous Oxide (N_2O) Emissions from Distillate Fuel (Fuel Consumption is in Gallons)							
Total Emissions (metric tons)	=	Adjusted Emission Factor (kg N_2O/gallon)	x	Fuel Consumed (gallons)	x	0.001 metric tons/kg		
Total Emissions (metric tons)	=	0.0001 kg N_2O/gallon	x	9,996 gallons	x	0.001 metric tons/kg	=	0.0010 metric tons N_2O

Total CH_4 from All Sources	=	**15.925 metric tons N_2O**

(Note, both methane and nitrous oxide emissions from stationary combustion are likely to be de minimis.)

Step 6: Convert CH_4 and N_2O Emissions to CO_2e and sum the subtotals.

Equation 11a	Converting Mass Estimates to Carbon Dioxide Equivalent					
Metric Tons of CO_2e	=	Metric Tons of GHG	x	GWP (SAR, 1996)		
Metric Tons of CO_2					=	1,300,822.6 metric tons CO_2
CH_4 Tons of CO_2e	=	19.88 metric tons CH_4	x	21 (GWP)	=	417.48 metric tons CO_2e
N_2O Tons of CO_2e	=	15.925 metric tons N_2O	x	310 (GWP)	=	4,936.75 metric tons CO_2e
				Total	=	**1,306,176.7 metric tons CO_2e**

Chapter 8 Indirect Emissions from Co-generation, Imported Steam, & District Heating or Cooling

Ⓒ Ⓓ	Chapter 8 applies to Category C and D only.
What you will find in Chapter 8	This chapter provides guidance on estimating indirect emissions from co-generation, imported steam, and district heating or cooling. The chapter includes the quantification methodology for co-generation and an example addressing indirect emissions from district heating.
Information you will need	You will need information about the type of co-generation, imported steam and heat, and imported cooling your organization uses, and the types and amounts of fuel consumed by the plant to generate that electricity, heating, or cooling. For example, for heat or electricity from a co-generation facility, you will need information about the plant's net heat production and net electricity production, in addition to your organization's own consumption of that power.

Chapter Overview

See Chapter 7
Direct Emissions from Stationary Sources

This chapter applies to organizations that purchase electricity, steam, heat, or cooling from a co-generation plant that they *do not own or operate*. Emissions associated with these sources are considered to be indirect. If you own or operate a co-generation plant, you should calculate your direct emissions from the combustion of the fossil fuels at the plant as described in Chapter 7.

Organizations with Both Energy Imports and Exports

You should calculate and report your energy inputs and exports separately. If you are a net positive importer of energy, you should report your positive net emissions along with your separate energy imports and exports, as these emissions will represent a portion of your indirect emissions from your energy consumption.

If you are a net negative energy importer (i.e energy exporters such as electricity generators) you should not subtract your negative net emissions associated with exported power from your total energy emissions, as this would not accurately reflect (and would unfairly discount) the amount of energy consumed by your operations. Hence, net negative energy importers should not report negative indirect emissions—your net indirect emissions in this case would be zero.

Consistent with the practice of accounting for emissions associated with imported energy, you should report any emissions resulting from the production of electricity, steam, heating, and cooling that are sold and exported to another party. The calculation to determine exported emissions follows the same basic approach as the process of allocating emissions

from cooling, i.e., by multiplying total emissions from generating the cooling by the fraction of energy exported.

Calculating Indirect Emissions from Heat and Power Produced at a Co-generation Facility

Emissions from co-generation facilities—also referred to as combined heat and power (CHP) plants—represent a special case for estimating indirect emissions. Because CHPs simultaneously produce electricity and heat, attributing total GHG emissions to each would result in double counting. Thus, when two or more different parties receive the energy streams from a CHP, GHG emissions must be determined and allocated separately for heat production and electricity production. Since the output from a CHP results simultaneously in heat and electricity, you can determine what "share" of total emissions is a result of electricity and heat by using a ratio based on the Btu content of heat and/or electricity relative to the CHP's total output.

The process for estimating indirect emissions from heat and power produced at a co-generation facility involves the following five steps:

1. Obtain emissions and power generation information from co-generation facility;
2. Calculate emissions attributable to net heat production and electricity production for the CHP;
3. Calculate emissions attributable to your portion of heat and electricity consumed;
4. Convert any Non-CO_2 emissions to carbon dioxide equivalent, as applicable; and
5. Sum CO2e

Additional guidance on estimating GHG emissions from co-generation electricity and heat can be found through the following:

- *Corporate GHG Accounting Calculation Tools*, prepared under the GHG Protocol Initiative by the World Resources Institute and World Business Council for Sustainable Development (October 2001). The tool entitled "Calculating CO2 Emissions from Stationary Sources" addresses emissions from co-generation facilities. **http://www.ghgprotocol.org/standard/tools.htm**.

- *Guidelines for the Measurement and Reporting of Emissions in the UK Emissions Trading Scheme*, prepared by the U.K. Department for Environment, Food and Rural Affairs (August 2001). **http://www.defra.gov.uk/environment/climatechange/trading**.

- *EPA Climate Leaders Inventory Protocol*, U.S. Environmental Protection Agency (in development as of August 2002). EPA's protocol includes a module focusing on indirect emissions from electricity and/or steam purchases. **http://www.epa.gov/climateleaders/index.html**.

❑ Step 1: Obtain emissions and power generation information from co-generation facility.

The process for estimating GHG emissions from co-generation electricity or heat produced will require you to obtain more information than just the kilowatt-hours or Btus consumed per unit of time. You will need to obtain the following from your energy supplier:

1. Total emissions of carbon dioxide (and methane and nitrous oxide when they are being reported) from the co-generation facility,

2. Total electricity production using CHP, and

3. Net heat production using CHP

Net heat production refers to the useful heat that is produced in a CHP, minus whatever heat returns to the boiler as steam condensate, as shown in Equation 8a.

Equation 8a	Net Heat Production			
Net Heat Production (MMBtu)	=	Heat of Steam Export (MMBtu)	–	Heat of Return Condensate (MMBtu)

If your CHP power provider has not estimated total emissions of GHGs, you will need to follow the steps in Chapter 7 on Direct Emissions from Stationary Combustion, page 7.2, to estimate total emissions. In that case, you will also need to obtain information about total amount and type of fuel consumed at the co-generation plant.

❑ Step 2: Calculate emissions attributable to net heat production and electricity production for the CHP.

Once you have determined total emissions from the CHP, you can calculate emissions attributable to heat production, as shown in Equation 8b, and emissions attributable to electricity production, as shown in Equation 8c. You will note, the emissions attributable to each are based on a ratio that reflects MMBtus produced for each individual energy type as compared with the total energy produced (net heat production plus electricity production).

Note, the Registry assumes that efficiency loss rates are the same for net heat production and electricity production, and thus does not reflect any efficiency loss values in determining CHP emissions attributable to either heat or electricity production.

Equation 8b	CHP Emissions Attributable to Heat Production								
CHP Emissions Attributable to Heat Production (metric tons)	=	Total CHP Emissions (metric tons)	x	[Net Heat Production (MMBtu)]	÷	[Net Heat Production (MMBtu)	+	Electricity Production (MMBtu)]

Equation 8c	CHP Emissions Attributable to Electricity Production								
CHP Emissions Attributable to Electricity Production (metric tons)	=	Total CHP Emissions (metric tons)	x	[Electricity Production (MMBtu)]	÷	[Net Heat Production (MMBtu)	+	Electricity Production (MMBtu)]

❑ Step 3: Calculate emissions attributable to your portion of heat and electricity consumed.

Once you have determined total emissions attributable to heat or production or electricity production, you will need to determine your portion of electricity or heat consumed from the CHP, and thus your indirect portion of associated GHG emissions. Use Equations 8d and 8e to calculate your share of emissions, as appropriate.

Equation 8d	Indirect Emissions Attributable to Electricity Consumption							
Indirect Emissions Attributable to Electricity Consumption (metric tons)	=	CHP Emissions Attributable to Electricity Production (metric tons)	x	[	Your Electricity Consumption (MMBtu)	÷	CHP Electricity Production (MMBtu)	]

Equation 8e	Indirect Emissions Attributable to Electricity Consumption							
Indirect Emissions Attributable to Heat Consumption (metric tons)	=	CHP Emissions Attributable to Heat Production (metric tons)	x	[	Your Heat Consumption (MMBtu)	÷	CHP Net Heat Production (MMBtu)	]

❑ Step 4: Convert any Non-CO_2 emissions to carbon dioxide equivalent, as applicable.

Use the IPCC Second Assessment Report (SAR) global warming potential factors from Table 5-2 in Chapter 5 to convert methane and nitrous oxide to carbon dioxide equivalent. (See Equation 5b in Chapter 5.)

See Chapter 5 Table 5-2 Global Warming Potential Factors

See Chapter 5 Equation 5b Converting Mass Estimates to CO_2e

❑ Step 5: Sum all CO2e.

Calculating Indirect GHG Emissions from Imported Steam or District Heating from a Conventional Boiler Plant

The process of quantifying indirect emissions from imported steam or district heating largely mirrors that for estimating direct emissions from stationary combustion—with the addition of one step that incorporates efficiency losses for steam generation and distribution.

See Chapter 7 Tables 7-2, 7-3, 7-4 Select the Appropriate Adjusted Emission Factor for each Fuel

In order to estimate fuel consumption at the boiler, you can use the heat contained in the steam or hot water you receive, rather than rely on actual fuel measurements (which may not be available). (See Equation 8h.) Once you have estimated fuel consumption at the boiler, you can calculate total emissions by multiplying total energy by the emission factors provided in Tables 7-2, 7-3, and 7-4. If you know the efficiency factor for generation and transmission of imported steam or hot water, please use it in your calculation. (Note, heat loss during transmission should be reflected in this efficiency factor.) If the efficiency is unknown, simply use an efficiency factor of 75%.

Use the following four steps to estimate your total GHG emissions from imported steam or district heating:

1. Determine energy obtained from steam or district heating;
2. Determine energy consumed at the steam or district heating plant;
3. Determine appropriate emission factor for the fuel; and
4. Multiply energy consumed by the emissions factor to derive emission estimates.

❑ Step 1: Determine energy obtained from steam or district heating.

You can use monthly energy bills to determine the energy obtained from steam or district heating. The monthly bills should be summed together over the year to give annual consumption. You will want to total your data in million Btus (MMBtu).

Heating Bills Expressed in Therms. If your heating bills are expressed in therms, you can convert the values to MMBtu by multiplying by 0.1, as shown in the Equation 8g below.

Equation 8g	Energy Consumption for Steam				
Energy Consumption (MMBtu)	=	Energy Consumption (therms)	x	0.1 MMBtu/ therm	

Heating Bills Expressed in Pounds of Steam. If your steam consumption is billed in pounds (lbs), you either need to monitor the temperature and pressure of the steam you have received, or request it from the steam supplier. Calculate the thermal energy of the steam using saturated water at 212°F as the reference.[9] The thermal energy consumption is calculated as the difference between the ***enthalpy*** of the steam at the delivered conditions and the enthalpy (or heat content) of the saturated water at the reference conditions (or heat content). The enthalpy of the steam can be found in standard steam tables.[10] The enthalpy of saturated water at the reference conditions is 180 Btus per pound. The thermal energy consumption for the steam can then be calculated as shown in Equation 9h.

Equation 8h	Energy Consumption for Steam								
Energy Consumption (MMBtu)	=	[	Enthalpy of Delivered Steam (Btu/lb)	–	180 (Btu/lb)	]	x	Mass of Steam Consumed (lbs)	÷ 1,000,000 (Btu/MMBtu)

❑ Step 2: Determine the energy consumed by the steam or district heating plant.

Once you have estimated your steam consumption, you can estimate the energy consumed at the steam or district heating plant by dividing your energy consumption by the system efficiency. Use Equation 8i if you can obtain information about the efficiency of the boiler used to produce the steam or hot water and any transport losses that occur in delivering the steam. If you do not have that information, use Equation 8j.

Equation 8i	Energy Input									
Energy Input (MMBtu)	=	Energy Use for Heating (MMBtu)	÷	[	Fractional Boiler Efficiency	x	(	1	–	Fractional Transport Losses)]

If transport losses or boiler efficiency vary seasonally, energy input should be calculated using Equation 8i on a monthly or seasonal basis, and summing together the results to arrive at the total annual energy input you will need in Step 4.

[9] American Petroleum Institute, *Compendium of Greenhouse Gas Emissions Estimation Methodologies for the Oil and Gas Industry* (2001).

[10] See, for example, J.H. Keenan, Keyes, Hill, *et* al, *Steam Tables* (1969) and R.J. Reed, Ed., *North American Combustion Handbook, Second Edition* (1978), pages 349.

Estimated System Efficiency. As shown in Equation 8j, if you are unable to obtain the system efficiency, divide energy consumption from Step 1 by an estimated total efficiency—boiler efficiency and transport losses combined—of 75%.

Equation 8j	Energy Input			
Energy Input (MMBtu)	=	Energy Consumption (MMBtu)	÷	0.75

❑ Step 3: Determine appropriate emission factors.

Because emissions will vary with fuel type, you need to know the type of fuel that is burned in the plant supplying your steam or hot water. You can obtain this information from the plant's energy supplier. Once you have the type of fuel being combusted to generate the steam or hot water, use the emission factors for stationary fuel combustion in Tables 7-2, 7-3, or 7-4 in Chapter 7.

See Chapter 7
Tables 7-2, 7-3, 7-4
Emission Factors for Stationary Combustion

❑ Step 4: Calculate total emissions from imported steam or district heating.

Once you have both the value of total energy consumed from Step 2 and the appropriate emission factor from Step 3, use Equation 8k to calculate total GHG emissions from imported steam or hot water.

Equation 8k	Total Emissions				
Total Emissions (metric tons)	=	Energy Consumed (MMBtu)	x	Emission Factor (kg/MMBtu)	x 0.001 metric tons/kg

❑ Step 5: Convert any CH_4 and N_2O Emissions to CO_2e and sum all subtotals.

Use the IPCC Second Assessment Report (SAR) global warming potential factors from Table 5-2 in Chapter 5 to convert methane and nitrous oxide to carbon dioxide equivalent. (See Equation 5b in Chapter 5.)

See Chapter 5
Table 5-2
Global Warming Potential Factors

Calculating Indirect GHG Emissions from District Cooling

When you purchase cooling services using district cooling, the compressor system that produces the cooling is driven by either electricity or fossil fuel combustion. Your indirect emissions from district cooling represents your share of the total cooling demand from the cooling plant, multiplied by the total GHG emissions generated by that plant. You can begin the process of estimating your indirect emissions from district cooling by summing together the total cooling on your monthly cooling bills.

Once you have determined your total cooling, you can use one of two options—either a simplified or more detailed approach—to estimate your GHG emissions.

Simplified Approach (Option 1). The simplified approach uses an estimated value for the ratio of cooling demand to energy input for the cooling plant, known as the "coefficient of performance" (COP). Thus, this approach allows you to estimate the portion of energy used at the district cooling plant directly attributable to your cooling.

Detailed Approach (Option 2). COPs for chillers may vary by more than an order of magnitude, making it necessary to obtain the COP for the cooling plant. The more detailed approach allows you to determine the total cooling-related emissions from the district cooling plant and your fraction of total load hours.

Option 1 Simplified Approach Using an Estimated Coefficient of Performance

❑ Step 1: Determine your annual cooling demand.

While your cooling bill may be reported in terms of million Btu (MMBtu), it will typically report cooling demand in ton-hours. You can convert ton-hours of cooling demand to MMBtu using Equation 8m. If you are billed monthly, sum together your cooling demand for every month to yield an annual total.

Equation 8m	Annual Cooling Demand					
Cooling Demand (MMBtu)	=	Cooling Demand (ton-hours)	x	12,000 (Btus/ton-hour)	x	0.000001 (MMBtu/Btu)

❑ Step 2: Estimate COP for the plant's cooling system.

If you are able to obtain the COP for the cooling plant, proceed to Step 3. However, if you cannot obtain the COP itself, try to determine the type of chiller used by the district cooling plant. With that information, a rough estimate of the COP may be selected from the typical values shown in Table 8-1.

Table 8-1. Typical Chiller Coefficients of Performance

Equipment Type	Coefficient of Performance (COP)	Energy Source
Absorption Chiller	0.8	Natural Gas
Engine-Driven Compressor	1.2	Natural Gas
Electric-Driven Compressor	4.2	Electricity

❑ Step 3: Determine energy input.

Use Equation 8n to determine the energy input to the system resulting from your cooling demand.

Equation 8n	Energy Input			
Energy Input (MMBtu)	=	Cooling Demand (MMBtu)	÷	COP

For an electric driven compressor, convert the energy input in MMBtu into kWh by multiplying by 293.1.

❑ Step 4: Calculate total GHG emissions resulting from cooling.

Where Cooling Plant Uses Absorption Chillers or Engine-Driven Compressors. For cooling plants that use absorption chillers or engine-driven compressors, determine what type of fuel the cooling plant consumes. If you can determine what type of fuel is being used,

multiply the energy input by the appropriate emission factor in Tables 7-2, 7-3, and 7-4. If the fuel type cannot be determined, assume natural gas and multiply the energy input by the emission factors for natural gas.

Equation 8p	Total Cooling Emissions				
Total Cooling Emissions (metric tons)	=	Energy Input (MMBtu)	x	Emission Factor (kg/MMBtu)	x 0.001 metric tons/kg

Where Cooling Plant Uses Electric-Driven Compressors. If the cooling plant uses an electrically driven compressor, calculate emissions using the procedures described in Chapter 5 on indirect emissions from electricity consumption, based on the amount of electricity consumption calculated in Step 1 above.

See Chapter 5
Indirect Emissions from Electricity

Option 2 Detailed Approach Based on Cooling Plant Emissions and Your Organization's Share of Total Cooling Demand

❑ Step 1: Determine total cooling-related emissions from the district cooling plant.

District cooling plants take a variety of forms and may produce electricity, hot water, or steam for sale in addition to cooling.

Where Cooling Plant Produces Only Cooling. In the simplest case, all of the fuel consumed by the plant is used to provide cooling. In that case, you will be able to determine total cooling emissions based on (1) total indirect emissions from cooling plant electricity and heat consumption (metric tons), and (2) total direct emissions from cooling plant fuel combustion (metric tons).

The process for calculating the direct and indirect emissions used in Equation 8q is identical to those described in Chapters 5 through 7 above. You will need to obtain the emission values from the district cooling plant, or calculate the emissions based on the fuel consumption, as well as electricity and steam consumption information, provided by the plant.

See Chapters 5-7
Calculating Indirect and Direct GHG Emissions

Where Cooling Plant Produces More than Cooling. In many cases, the simple situation described above will not apply. Instead, the cooling plant will be integrated into a combined heat and power plant, where some of the steam and electricity produced by the plant may be used for cooling, and some may be used for other purposes. In this case, the emissions from the combined heat and power plant will need to be allocated between heating and electricity production (or shaft work in the case of internal combustion engines), and these emissions will have to be scaled by the fraction of the heat or electricity that is used for cooling, as opposed to being used for other purposes. The attribution of emissions to the heat and power streams is done in the same manner as described above.

See This Chapter
Emissions from Heat and Power Systems

Equation 8q **Total Cooling Emissions**

$$\text{Total Cooling Emissions (metric tons)} = \left[\text{Fraction of CHP Electricity Prod. Used for Cooling} \times \left(\left(\text{Total Fuel Heat Input (MMBtu)} - \text{Net Heat Production (MMBtu)}\right) \div 0.9\right) \div \text{Total Fuel Heat Input (MMBtu)}\right] + \left[\text{Fraction of CHP Heat Prod. Used for Cooling (kWh)} \times \left(\text{Net Heat Production (MMBtu)} \div 0.9 \times \text{Total Fuel Heat Input (MMBtu}\right) \times \text{Total CHP Emissions (metric tons)}\right]$$

Equation 8q assumes 90% efficiency for boiler emissions and allocates all other waste heat to electricity generation.

❑ Step 2: Determine fraction of cooling emissions attributable to your operations.

The next step in calculating your GHG emissions from cooling is to scale the total plant cooling emissions by the percentage of your share of the cooling load. Equation 8r demonstrates how the total cooling load on the plant is scaled to determine your cooling emissions.

Equation 8r **Annual Cooling Demand**

$$\text{Participant Cooling Emissions (metric tons)} = \text{Total Cooling Emissions (metric tons)} \times \left[\text{Participant Cooling Load (ton-hours)} \div \text{Total Cooling Load (ton- hours)}\right]$$

❑ Step 3: Determine total yearly emissions.

For each month (or longer period) of the year, cooling emissions should be calculated as described in Steps 1 and 2, above. The duration of the periods for which the emissions are calculated will depend on the data available. Ideally, calculations would be made monthly for cooling plants integrated with CHPs, as emissions associated with cooling will depend on how the CHP outputs are distributed. If data for making these calculations are not available on a monthly basis, then longer periods will be used. In either case, the emissions for each period must be summed over the year to obtain the annual total.

Example: Indirect Emissions from District Heating

Socal Manufacturing Company

The Socal Manufacturing Company is a Category C organization that imports steam at its Bakersfield facility. The steam is imported from a conventional natural gas-fired boiler. The Boiler efficiency is 85% and the loss factor is 6%.

Step 1: Determine energy obtained from steam or district heating.

Since its energy consumption is provided in Therms on its monthly billing, Socal uses Equation 8g to determine energy consumption. Socal consumed 6,000 Therms in the past year.

Equation 8g	Energy Consumption for Steam					
Energy Consumption (MMBtu)	=	Energy Consumption (therms)	x	0.1 MMBtu/ therm		
Steam Energy Consumption (MMBtu)	=	6,000 Therms	x	0.1 MMBtu/ therm	=	600 MMBtu

Step 2: Determine the energy consumed by the steam or district heating plant.

Socal uses its boiler efficiency of 85% and loss factor of 6% to calculate its Energy Input.

Equation 8i	Energy Input										
Energy Input (MMBtu)	=	Energy Use for Heating (MMBtu)	÷	[Fractional Boiler Efficiency	x	(1	–	Fractional Transport Losses	)]		
Energy Input (MMBtu)	=	600 MMBtu	÷	[0.85 (boiler efficiency)	x	(1	–	0.06	)]	=	**750.94 MMBtu**

Step 3: Determine appropriate emission factors.

Since natural gas is used to generate the steam, Socal uses emissions factors for natural gas in MMBtus from Tables 7-2 and 7-3.

Table 8-1. Emission Factors for Natural Gas

Fuel	Gas Emitted	Emission Factor
Natural Gas	Carbon Dioxide	52.78 kg/MMBtu
Natural Gas	Methane	0.0059 kg/MMBtu
Natural Gas	Nitrous Oxide	0.0001 kg/MMBtu

Step 4: Calculate Total Emissions.

Equation 8k	Total Emissions							
Total Emissions (metric tons)	=	Energy Consumed (MMBtu)	x	Emission Factor (kg/MMBtu)	x	0.001 metric tons/kg		
Total Carbon Dioxide (CO_2) Emissions (kg)	=	750.94 MMBtu	x	52.78 kg/MMBtu	x	0.001 metric tons/kg	=	39.63 metric tons CO_2
Total Methane (CH_4) Emissions (kg)	=	750.94 MMBtu	x	0.0059 kg/MMBtu	x	0.001 metric tons/kg	=	.0044 metric tons CH_4
Total Nitrous Oxide (N_2O) Emissions (kg)	=	750.94 MMBtu	x	0.0001 kg/MMBtu	x	0.001 metric tons/kg	=	0.000075 metric tons N_2O

Steam-related methane and nitrous oxide emissions are likely to be de minimis.

Step 5: Convert CH_4 and N_2O Emissions to CO_2e and sum all subtotals.

Equation 5b	Converting Mass Estimates to Carbon Dioxide Equivalent					
Metric Tons of CO_2e	=	Metric Tons of GHG	x	GWP (SAR, 1996)		
Metric Tons of CO_2					=	39.63 metric tons CO_2
CH_4 Metric Tons of CO_2e	=	0.0044 metric tons CH_4	x	21 (GWP)	=	0.0924 metric tons CO_2e
N_2O Metric Tons of CO_2e	=	0.000075 metric tons N_2O	x	310 (GWP)	=	0.0233 metric tons CO_2e
				Total	=	**39.746 metric tons CO_2e**

Chapter 9 Direct Emissions from Manufacturing Processes

(D)	Chapter 9 applies to Category D organizations only.
What you will find in Chapter 9	This chapter provides several resources you may use to calculate your direct emissions from manufacturing processes.
Information you will need	Your information needs will be based on the calculation methodology you select.

The Registry is still formulating the specific guidelines and rules for calculating direct GHG emissions from manufacturing processes. In the meantime, a variety of useful resources exist that may help you to calculate your process emissions. The Registry recommends reviewing relevant methodologies and/or calculations with technical assistance providers or other environmental experts.

The following is a list of resources for use in making your calculations:

- *Corporate GHG Accounting Calculation Tools*, prepared under the GHG Protocol Initiative by the World Resources Institute and World Business Council for Sustainable Development (October 2001). The following list of calculation tools are available form the GHG Protocol Initiative website, at **http://www.ghgprotocol.org/standard/tools.htm**:
  - Calculating N_20 Emissions from the Production of Adipic Acid
  - Calculating CO_2 and PFC Emissions from the Production of Aluminum
  - Calculating CO_2 Emissions from the Production of Ammonia
  - Calculating CO_2 Emissions from the Production of Cement
  - Calculating CO_2 Emissions from the Production of Cement
  - Calculating HFC-23 Emissions from the Production of HCFC-22
  - Calculating CO_2 Emissions from the Production of Iron and Steel
  - Calculating CO_2 Emissions from the Production of Lime
  - Calculating N_20 Emissions from the Production of Nitric Acid
  - Calculating PFC Emissions from the Production of Semi-Conductor Wafers.
- *Guidelines for the Measurement and Reporting of Emissions in the UK Emissions Trading Scheme*, prepared by the U.K. Department for Environment, Food and Rural Affairs (August 2001). The following list of calculation tools for process-based CO_2 emissions are available in Annex B of the UK Guidelines, located at **http://www.defra.gov.uk/environment/climatechange/trading**:
  - Protocol B1: Cement Manufacture
  - Protocol B2: Lime Production
  - Protocol B3: Limestone and Dolomite Use
  - Protocol B4: Soda Ash
  - Protocol B5: Ammonia – Use of Fuels as Feedstock
  - Protocol B6: Metal Production

- Protocol B7: Waste Incineration – Municipal Solid Waste (MSW) and Sewage.

(Note, the UK Guidelines for non-CO2 process emissions are currently in development.)

- *Guidance to the California Climate Action Registry: General Reporting Protocol*, *Appendix B and Appendix C*, prepared by the California Energy Commission, P500-02-005F (June 2002), located at **www.climateregistry.org**. The following list of citations provide some guidance on quantifying process emissions:

  - **CO_2** emissions from **cement production**: Appendix B page B-5, Appendix C page C-1;
  - **CO_2** emissions from **lime production**: Appendix B page B-11, Appendix C page C-6;
  - **CO_2** emissions from **limestone and dolomite consumption**: Appendix B page B-12;
  - **N_2O** from **nitric acid production**: Appendix B page B-16, Appendix C page C-7;
  - **FC-23, CF_4, C_2F_6, and SF_6** emissions from **semiconductor manufacturing**: Appendix B page B-18, Appendix C page C-9;
  - **CO_2** emissions from **soda ash production and consumption**: Appendix B page B-19, Appendix C page C-11.

- *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2000*, U.S. Environmental Protection Agency (April 2002). See **http://www.epa.gov/globalwarming/publications/emissions/us2002/index.html**.

- *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories Reference Manual (Volume 3)*, prepared by the Intergovernmental Panel on Climate Change (1996). Volume 3 addresses GHG emissions from industrial processes. See **http://www.ipcc-nggip.iges.or.jp/public/gl/invs6b.htm**.

- Inventory of California Greenhouse Gas Emissions and Sinks: 1990-1999, prepared by the California Energy Commission (in development as of the time of publication of this Protocol). See **http://www.energy.ca.gov/global_climate_change**.

- *EPA Climate Leaders Inventory Protocol*, U.S. Environmental Protection Agency (in development as of the time of publication of this Protocol). See **http://www.epa.gov/climateleaders/index.html**.

Chapter 10 Direct Fugitive Emissions

(D)	Chapter 10 applies to Category D only.
What you will find in Chapter 10	This chapter provides guidance on determining direct fugitive emissions, specific guidance and an example on fugitive refrigerant emissions of HFCs, and guidance on additional resources to use for other fugitive emissions.
Information you will need	To complete this chapter you will need information on: the types and quantities of air conditioning equipment, total refrigerant charge, annual leak rates, and the types of refrigerant, as applicable.
Cross-References	See Chapter 11 on De Minimis Emissions and Materiality in estimating HFCs from refrigerants.

Chapter Overview

The majority of fugitive GHG emissions are specific to various industrial sectors or processes, including: manufacturing, natural gas transport and distribution, coal mining, waste management, wastewater treatment, and refrigerant leakage from air conditioning and refrigeration equipment.

Air Conditioning and Refrigeration Emissions. This chapter provides specific guidance on direct fugitive emissions from refrigeration systems below.

Other Fugitive Emissions. The Registry is still formulating the specific guidelines and rules involved in calculating other direct fugitive GHG emissions. In the meantime, a variety of useful resources exist that may help you to calculate your fugitive emissions. The Registry recommends reviewing relevant methodologies and/or calculations with technical assistance providers or other environmental experts.

The following is a list of resources for use in making your calculations:

- *Corporate GHG Accounting Calculation Tools*, prepared under the GHG Protocol Initiative by the World Resources Institute and World Business Council for Sustainable Development (October 2001). **http://www.ghgprotocol.org/standard/tools.htm**.
- *Guidelines for the Measurement and Reporting of Emissions in the UK Emissions Trading Scheme*, prepared by the U.K. Department for Environment, Food and Rural Affairs (August 2001). **http://www.defra.gov.uk/environment/climatechange/trading**.
- *EPA Climate Leaders Inventory Protocol*, U.S. Environmental Protection Agency (in development as of August 2002). EPA's protocol includes core modules addressing

methane emissions from solid waste disposal at landfills as well as HFC emissions from refrigeration/air conditioning use. **http://www.epa.gov/climateleaders/index.html**.

- *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2000*, U.S. Environmental Protection Agency (April 2002). **http://www.epa.gov/globalwarming/publications/emissions/us2002/index.html**.

- *Inventory of California Greenhouse Gas Emissions and Sinks: 1990-1999*, prepared by the California Energy Commission (in development as of the time of publication of this Protocol). See **http://www.energy.ca.gov/global_climate_change**.

- American Petroleum Institute, *Compendium of Greenhouse Gas Emissions Estimation Methodologies for the Oil and Gas Industry* (2001).

- *Guidance to the California Climate Action Registry: General Reporting Protocol*, *Appendix B and Appendix C*, prepared by the California Energy Commission, P500-02-005F (June 2002), located at **www.climateregistry.org**. The following list of citations provide some guidance on quantifying direct fugitive emissions:

    - **CH_4** emissions from **coal mining**: Appendix B page B-5, Appendix C page C-3;
    - **CH_4** emissions from **natural gas systems**: Appendix B page B-15, Appendix C page C-9;
    - **CH_4** emissions from **petroleum systems**: Appendix B page B-17, Appendix C page C-9;
    - **SF6** emissions from electricity transmission and distribution equipment: Appendix B page B-6, Appendix C page C-4;
    - **N_2O** emissions from **wastewater**: Appendix B page B-9;
    - **CH_4** emissions from **wastewater**: Appendix B page B-15;
    - **CH_4** emissions from **landfills**: Appendix B page B-10;
    - **N_2O** emissions from **agricultural soil management**: Appendix B page B-2;
    - **CH_4** emissions from livestock as a result of **enteric fermentation**: Appendix B page B-7;
    - **CH_4 and N_2O** emissions from **manure management**: Appendix B page B-13;
    - **CH_4** emissions from **rice cultivation**: Appendix B page B-18.

Calculating Direct Fugitive Emissions from Refrigeration Systems

Leakage from refrigeration systems, such as air conditioners and refrigerators, is common across a wide range of entities. Only those refrigerants that contain or consist of compounds of the required GHGs should be reported. Hydrofluorocarbons (HFCs) are the primary GHG of concern for refrigeration systems, particularly for motor vehicle air conditioners. Today, HFC-134a is the standard refrigerant for mobile air conditioning systems. For most Registry participants, emissions of HFCs from air conditioning systems will be negligible in comparison to other GHG emissions.

Three-Step Process. Use the following three step process to calculate HFC emissions from air conditioners:

1. Determine whether HFC emissions are material or de minimis;
2. Determine the base inventory for each HFC and calculate changes to the base inventory over the past year; and
3. Convert each HFC emission to CO_2e.

Step 1 estimates whether your fugitive emissions are material and warrant a more comprehensive review. If the fugitive emissions are not material, and you wish to categorize them as de minimis, you do not need to complete this section. To perform the materiality analysis, you will need information on:

- The types and quantities of air conditioning equipment;
- The total refrigerant charge;
- The annual leak rates; and
- The types of refrigerant

If you find that your fugitive emissions are indeed material, continue to Steps 2 and 3 for a more accurate quantification of HFC emissions.

❑ Step 1: Determine whether HFC Emissions are material or de minimis.

This step is the first tier approach that allows an entity to roughly estimate emissions and determine whether HFC emissions from air conditioning systems are material or de minimis. Consistent with the Registry's definition of materiality, HFC emissions from air conditioners greater than or equal to 5% of a participant's total emission are considered material, assuming the participant has no other de minimis emissions. Fugitive emissions less than 5% are considered de minimis, and can be ignored as long as total de minimis emissions are less than 5%. However, if emissions are considered substantial and possibly material, then a more comprehensive and accurate mass balance approach is required to determine actual emissions.

Upper Bounds of Air Conditioner Loss Rates. Table 10-1 provides upper bounds values for leakage rates for the purposes of determining de minimis levels, refrigerant charges, and type of refrigerant for various refrigeration systems. (Note, all values are estimates and are intended to serve as guidelines and not default values.) Several of the refrigerants listed in Table 10-1 are blends of HFCs. The composition of these blends is shown in Table 10-2. Note, **typical leakage rates** are included in Table 10-1 for estimation only, and should not be used in calculating de minimis levels.

Table 10-1. Refrigerant Loss Rates

Type of AC Systems	Upper Bounds Annual Loss Rate	Refrigerant Charge (kg)	Type of Refrigerant
Large Automobile	35 %	1.0	HFC-134a
Small Automobile	35 %	0.5	HFC-134a
Residential Central Air System (3 ton)	35 %	2.8	R407C
Commercial AC System (7 ton)	35 %	6.9	R407C
Commercial Chiller (350 ton)	35 %	480	HFC-123
Commercial Chiller (350 ton)	35 %	432	HFC-134a
Commercial Chiller (1000 ton)	35 %	1,225	HFC-123
Commercial Chiller (1000 ton)	35 %	1,120	HFC-134a
Direct Expansion (DX) Central Refrigeration System	15 %	6% of floor area (ft^2)	R404A,R507
Water-Cooled Distributed System	15 %	0.66% of floor area (ft^2)	R404A,R507
Secondary Loop System	15 %	1.5% of floor area (ft^2)	R404A,R507

Note: Information included in this table is based on Alliance for Responsible Atmospheric Policy, *Global comparative analysis of HFC and Alternative Technologies for Refrigeration, Air Conditioning, Foam, Solvent, Aerosol Propellant, and Fire protection Applications, Final Report* (March 2002), at **http://www.arap.org/adlittle/toc.html**.

Table 10-2. Composition of Refrigerant Blends				
Blend	**HFC-32**	**HFC-125**	**HFC-134a**	**HFC-143a**
R404A	NA	44%	4%	52%
R407C	23%	25%	52%	NA
R507	NA	50%	NA	50%
R507	NA	50%	NA	50%

Source: U.S. Environmental Protection Agency, *Composition of Refrigerant Blends* (May 1998), **http://www.epa.gov/ozone/title6/snap/lists/refblend.html**.

Using **assumed annual loss rates** and **refrigerant change** values from Table 10-1, apply Equation 10a to estimate HFC material or de minimis emissions from refrigeration.

Equation 10a	**HFC Emissions from Refrigerant Leakage**			
HFC Emissions from Refrigerant Leakage (kg)	=	Total Annual Refrigerant Charge (kg)	x	Assumed Annual Leak Rate (%)

See Chapter 5
Table 5-2
Global Warming Potential Factors

Next, use the IPCC Second Assessment Report (SAR) global warming potential factors from Table 5-2 in Chapter 5 to convert HFCs to carbon dioxide equivalent. (See Equation 5b in Chapter 5.) If the sum of the CO_2e emissions for HFC (plus other estimated de minimis emissions) is less than 5% of total assumed emissions, you do not need to report the HFC emissions.

If the screening calculations of the HFC emissions indicate that they are material, more accurate means of quantification are necessary, as outlined in Steps 2-4 below. If your emissions are de minimis in combination with other de minimis emissions from your organization, you do not need to report fugitive emissions.

❑ Step 2: Mass-Balance Calculation: Determine base inventory for each HFC and calculate changes to base inventory.

Step 2 utilizes a comprehensive, mass-balance approach to accurately determine HFC emissions. Essentially, the mass-balance method works by starting with a base inventory of all HFCs in use, and adjusts that total based on purchases and sales of HFCs, and changes to the total refrigerant charge remaining in the equipment. The used HFCs that cannot be accounted for are assumed to have been emitted to the atmosphere. The four elements of these adjustments and changes are described here, with references to Tables 10-3 and 10-4, as applicable.

Base Inventory. The first step in calculating HFC emissions is to determine the difference between the quantity of the HFC in storage at the beginning of the year (A) and the quantity in storage at the end of the year (B), as shown in Table 10-3. Note, this quantity will be negative if the inventory increases over the course of the year. Those HFCs contained in cylinders and other storage containers are considered to be HFCs "in inventory"—not HFCs held in operating equipment.

Table 10-3. Base Inventory		
	Inventory	**Amount (kgs)**
A	Beginning of year	
B	End of year	

Additions and subtractions refer to HFCs placed in or removed from the stored inventory, respectively. The next items in calculating HFC emissions include purchases or acquisitions of refrigerant, sales or disbursements or refrigerant, and any changes to total full charge of refrigeration equipment.

Purchases/Acquisitions of Refrigerant. This is the sum of all the HFCs acquired during the year either in storage containers or in equipment (C), as shown in Table 10-4.

Sales/Disbursements of Refrigerant. This is the sum of all the HFCs sold or otherwise disbursed during the year either in storage containers or in equipment (D).

Change to Total Full Charge of Equipment. This is the net change to the total equipment volume for a given HFC during the year (E). Note that it refers to the full and proper charge of the equipment rather than to the actual charge, which may reflect leakage. This term accounts for the fact that if new equipment is purchased, the HFC that is used to charge that new equipment should not be counted as an emission. On the other hand, it also accounts for the fact that if the amount of refrigerant recovered from retiring equipment is less than the full charge, then the difference between the full charge and the recovered amount has been emitted. Note that this quantity will be negative if the retiring equipment has a total full charge larger than the total full charge of the new equipment.

Table 10-4. Inventory Changes

	Inventory	Amount (kgs)
	Additions to Inventory	
1	Purchases of HFCs (including HFCs provided by equipment manufacturers with or inside new equipment)	
2	HFCs returned to the site after offsite recycling	
C	**Total Additions (add items 1-2)**	
	Subtractions from Inventory	
3	Returns of HFCs to supplier	
4	HFCs taken from storage and/or equipment and disposed of	
5	HFCs taken from storage and/or equipment and sent offsite for recycling or reclamation	
D	**Total Subtractions (add items 3-5)**	
	Change to Full Charge/Nameplate Capacity	
6	Total full charge of new equipment	
7	Total full charge of retiring equipment	
E	**Change to nameplate capacity (subtract item 7 from 6)**	

Use Equation 10b to sum the total annual emissions of each type of HFC.

Equation 10b	Total Annual Emissions
Total Annual Emissions	= A - B + C - D - E

❑ Step 3: Convert HFC emissions to CO_2e (and convert to metric tons) and sum all subtotals.

See Chapter 5
Table 5-2
Global Warming Potential Factors

Finally, use the IPCC Second Assessment Report (SAR) global warming potential factors from Table 5-2 in Chapter 5 to convert each HFC to carbon dioxide equivalent, and sum the totals. (See Equation 5b in Chapter 5.)

Example: Direct Fugitive Emissions from Refrigeration Systems

Produce Chillers, Inc.

Produce Chillers, Inc. is a Category D organization based in California that operates three large commercial chillers to refrigerate vegetable produce shortly after harvest, as well as three trucks.

Step 1: Determine whether HFC Emissions are material or de minimis.

Produce Chillers' first step is to determine whether its HFC emissions are material. Produce Chiller's AC types are shown in Table 10-5.

Table 10-1. Excerpt: Air Conditioner Loss Rates for Produce Chillers, Inc.

Type of AC Systems	Upper Bounds Annual Loss Rate	Refrigerant Charge (kg)	Type of Refrigerant
Large Automobile	35 %	1.0	HFC-134a
Commercial Chiller (1000 ton)	35 %	1,225	HFC-123

Produce Chillers then uses Equation 10a to estimate **assumed** HFC emissions from air conditioning derived from Table 10-1.

Equation 10a	Assumed HFC Emissions from Annual Air Conditioning									
HFC Emissions from Annual Air Conditioning (kg)	=	Total Annual Refrigerant Charge (kg)	x	Annual Leak Rate (%)	x	Number of Systems	x	.001 metric tons/kg		
Commercial Chiller (1000 ton)	=	1,225 kg	x	0.35	x	3	x	.001 metric tons/kg	=	1.286 metric tons HFC 123
HFC Emissions from Large Automobiles (kg)	=	1.0 kg	x	0.35	x	**3**	x	.001 metric tons/kg	=	.001 metric tons HFC 134a

Produce Chillers must then convert its assumed fugitive HFCs to CO_2e.

Equation 11a	Converting Mass Estimates to Carbon Dioxide Equivalent					
Metric tons of CO_2e	=	Metric tons of GHG	x	GWP (SAR, 1996)		
HFC-123 metric tons of CO_2e	=	1.286 metric tons HFC-123	x	11,700 (GWP)	=	15,046.2 metric tons CO_2e
HFC-134a metric tons of CO_2e	=	.001 metric tons HFC-134a	x	1,300(GWP)	=	1.3 metric tons CO_2e
				Total	=	**15,047.50 metric tons CO_2e**

Produce Chillers has estimated that their total GHG emissions equals 50,000 metric tons. Consequently, they may choose to not report de minimis emissions of 2,500 metric tons.

Considering their estimated fugitive emissions of HFC 123 will be material, but HFC 134a will be immaterial, they decide not to report their HFC 134a emissions. Produce Chillers must calculate its base inventory for HFC 123 now.

Step 2: Determine base inventory for HFC 123 and calculate changes to base inventory.

Produce Chillers increased its total vegetable produce refrigeration capacity by 18 percent with new equipment, decommissioned one refrigeration unit for recycling, and recharged several of its refrigeration units. It also purchased a new truck in the past year. Inventory at the beginning of the year equals 812.6 kg and at the end of the year equals 805.1 kg.

Table 10-3. Example: Base Inventory for Produce Chillers, Inc. – HFC-123 from Commercial Chillers

	Inventory	Amount (kgs)
A	Beginning of year	812.6
B	End of year	805.1

Using its purchase, change and charge records, Produce Chillers completes the following table (Table 10-4) to calculate its total annual emissions.

Table 10-4. Example: Inventory Changes for Produce Chillers, Inc. – HFC-123 from Commercial Chillers

	Inventory	Amount (kgs)
	Additions to Inventory	
1	Purchases of HFCs (including HFCs provided by equipment manufacturers with or inside new equipment)	197.5
2	HFCs returned to the site after offsite recycling	0.0
C	**Total Additions (add items 1-2)**	**197.5**
	Subtractions from Inventory	
3	Returns of HFCs to supplier	0.0
4	HFCs taken from storage and/or equipment and disposed of	0.0
5	HFCs taken from storage and/or equipment and sent offsite for recycling or reclamation	53.3
D	**Total Subtractions (add items 3-5)**	**53.3**
	Change to Full Charge/Nameplate Capacity	
6	Total full charge of new equipment	19.5
7	Total full charge of retiring equipment	0.0
E	**Change to nameplate capacity (subtract item 7 from 6)**	**19.5**

Equation 10b	Total Annual Emissions of HFC-123 (kgs)		
Total Annual Emissions	= A - B + C - D - E		
Total Annual Emissions HFC-123	= 812.6 – 805.1 + 197.5 – 53.3 – 19.5	=	132.2 kg HFC-123

Step 3: Convert HFC emissions to CO_2e and convert to metric tons.

Equation 11a	Converting Mass Estimates to Carbon Dioxide Equivalent								
Metric tons of CO_2e	=	Metric tons of GHG	x	GWP (SAR, 1996)					
HFC-123 metric tons of CO_2e	=	132.2 kg HFC-123	x	11,700 (GWP)	x	0.001 metric tons/kg	=	1.5467 metric tons CO_2e
						Total	=	**1.5467 metric tons CO_2e**

Part IV Completing and Submitting Your Report

Now that you have established your reporting parameters in Part II and quantified your emissions in Part III, you are ready to complete your annual GHG Emission Report, certify your emissions, and submit them to the Registry.

Chapter 11, *De Minimis Emissions and Materiality*, provides an explanation of material and de minimis emissions. De minimis emissions represent a quantity of GHG emissions from one or more sources, and/or one or more gases, which, when summed, equal less than 5% of your organization's total emissions.

Chapter 12, *Reporting Your Emissions*, describes the steps you need to follow to report your emissions using the CARROT online reporting tool, as well as the steps for formally registering your GHG Emission Report with the Registry once you have received certification from a certifier.

Chapter 13, *Certification*, explains the certification process. This chapter begins with an overview of the importance of certification, requirements for meeting certification standards, the process for identifying and working with certifiers, documentation and other items you will need to prepare for certification, the reports you and the Registry will receive at the conclusion of the process, and the process for correcting your GHG Emission Report, if necessary.

Chapter 11 De Minimis Emissions and Materiality

B C D	Chapter 11 applies to Category B, C, and D participants. **Category A** participants ***may*** need to review this chapter, based on the size and complexity of your organization.
What you will find in Chapter 11	This chapter provides guidance on determining material emissions that should be reported, and estimating de minimis emissions that will not need to be reported.
Information you will need	You will need information about the size and nature of GHG emitting operations throughout your organization, particularly to be able to identify emissions sources that would amount to less than 5% of your company's total emissions.
Cross-References	It will be useful to consider your geographical and organizational boundaries addressed in Chapters 1 and 2, operational boundaries considered in Chapter 4, and all relevant quantification issues raised in Chapters 5-10.

GHG Emissions Covered in This Protocol

You must evaluate what material emissions to include in your Emission Report, and what de minimis emissions may be left unreported. The Registry accepts GHG Emission Reports that include material emissions of the following six gases:

- Carbon Dioxide (CO_2)
- Methane (CH_4)
- Nitrous Oxide (N_2O)
- Hydrofluorocarbons (HFCs)
- Perfluorocarbons (PFCs)
- Sulfur Hexafluoride (SF_6).

You are encouraged to report all six gases when you join the Registry, but during your first three years of participation, you are only required to report your material CO_2 emissions. After your third year of participation in the Registry, you will be required to include emissions for ***all six gases*** in your GHG Emission Report, as applicable. (As discussed below, you will not be required to report emissions that fall below the de minimis threshold.)

Understanding Material and De Minimis Emissions

Materiality and De Minimis Emissions

For many participants, identifying, quantifying, and reporting the entirety of GHG emissions would be unduly burdensome and not cost-effective. Some participants may operate hundreds if not thousands of small facilities where the known emissions—including, for example, indirect emissions from electricity consumption or direct emissions from motor

vehicle operation—are a small fraction of larger emissions sources from industrial activities. As a result, the Registry allows your organization to set aside de minimis emissions that do not represent a material portion of your GHG emissions.

For the purposes of this Protocol, ***material*** emissions are any emissions of GHGs that are not de minimis in quantity when summed up across all applicable sources of the participating entity. In order to provide a consistent definition across all applicable emissions sources for large emitters as well as small, ***de minimis emissions*** for all Category A, B, C, and D organizations are defined as a quantity of GHG emissions from one or more sources, for one or more gases, which, when summed equal less than 5% of your organization's total *emissions.*

Rationale for Calculating De Minimis Emissions

Once you have calculated your total entity-wide emissions, you can determine if you want to refrain from reporting your de minimis emissions. De minimis emissions are not required to be reported to the Registry (but can be voluntarily reported). Particularly for large organizations, determining de minimis emissions may significantly reduce your reporting burden in subsequent reporting years.

Reporting Your Material Emissions

You must report no less than 95% of your organization's overall emissions—i.e., those emissions that are considered "material". Nevertheless, you are encouraged to quantify all of your material and de minimis emissions.

De Minimis Emissions and Geographic Boundaries

If you are reporting for California only, the 5% threshold for de minimis emissions refers to the sum of all emissions sources in the State of California. If you are reporting at the national level, the 5% threshold applies separately to U.S. emissions and to California emissions, as you are required to report each set of emissions separately.

See Chapter 1
Geographic Boundaries

Identifying De Minimis Emissions

The sources and gases that will be de minimis will vary from participant to participant. For example, fugitive GHG emissions can be expected to be de minimis for many participants but will likely be material for participants involved in the transportation and distribution of natural gas. Similarly, many participants will choose to select non-CO_2 gases as de minimis since non-CO_2 gas emissions are not significant for many operations. On the other hand, some companies where the majority of emissions are of non-CO_2 gases—such as gas transmission and distribution firms—are not likely to simply consider non-CO_2 emissions as de minimis.

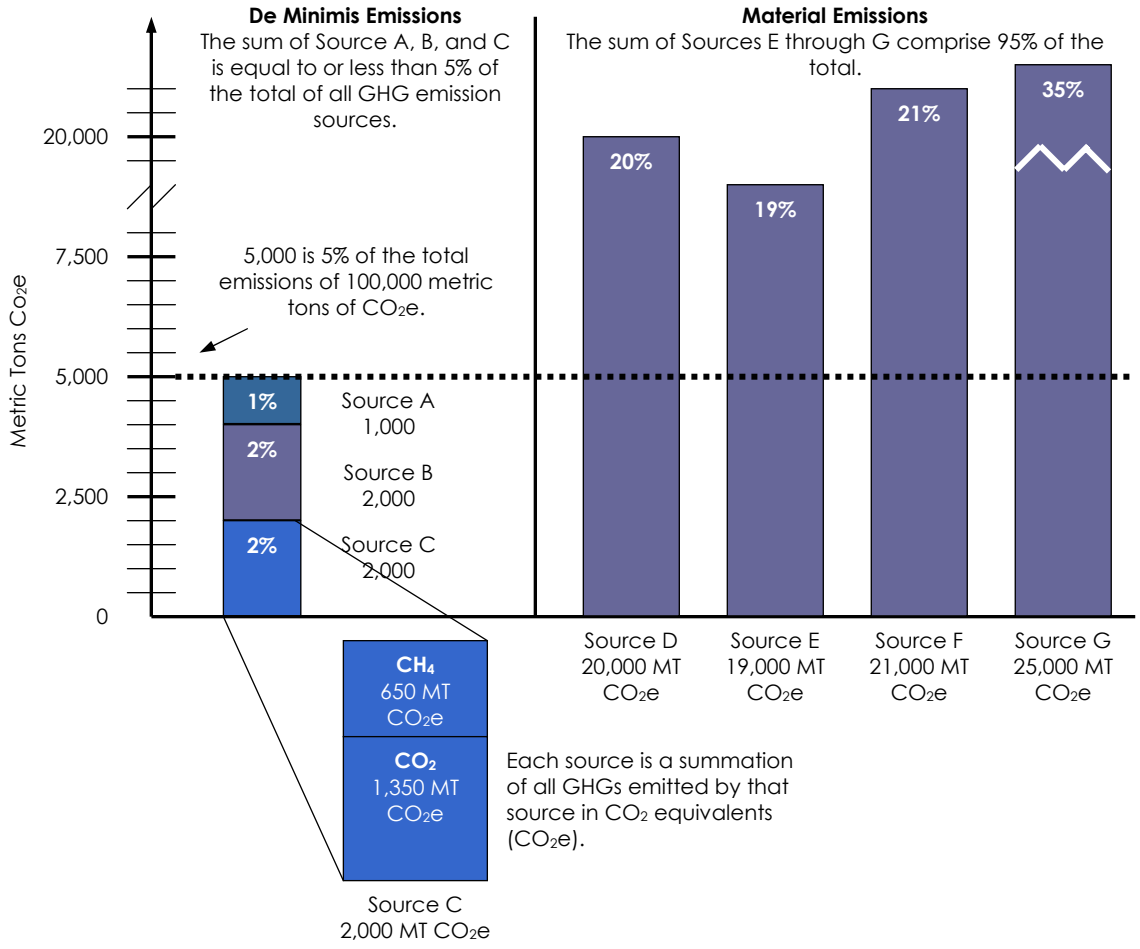
As demonstrated in the examples on the following pages, you have some discretion in identifying which de minimis emissions not to report. As Examples 11-1 and 11-2 demonstrate, there may be instances where you identify multiple sources as de minimis, which, when added together, equal less than 5% of your emissions. Example 11-3 illustrates how emissions of different kinds of gases can also be considered de minimis if their combined total is less than 5% of your overall emissions.

Example 11-1. Materiality where De Minimis Emissions are Five Percent or Less

Your company intends to report GHG emissions from seven sources (Sources A through G, as shown in Figure 11-1). You have calculated your total GHG inventory (including de minimis emissions) to determine the 5% threshold. Your total emissions inventory from all seven sources is 100,000 metric tons CO_2 e. Therefore, the 5% de minimis threshold is 5,000 metric tons CO_2 e. This means that you can decide which 5,000 metric tons of emissions you want to classify as de minimis.

The sum of the GHG emissions from Source A, Source B, and Source C is equal to 5% of your company's total emissions or 5,000 metric tons. As a result, you may choose not to report emissions from Source A, Source B, and Source C as they are de minimis sources. Note, however, that each source is the sum of all GHGs emitted for that source. For example, Source C is a combination of 1,350 metric tons CO_2 equivalent and 650 metric tons of CO_2 e of methane, for a total of 2,000 metric tons of CO_2 e

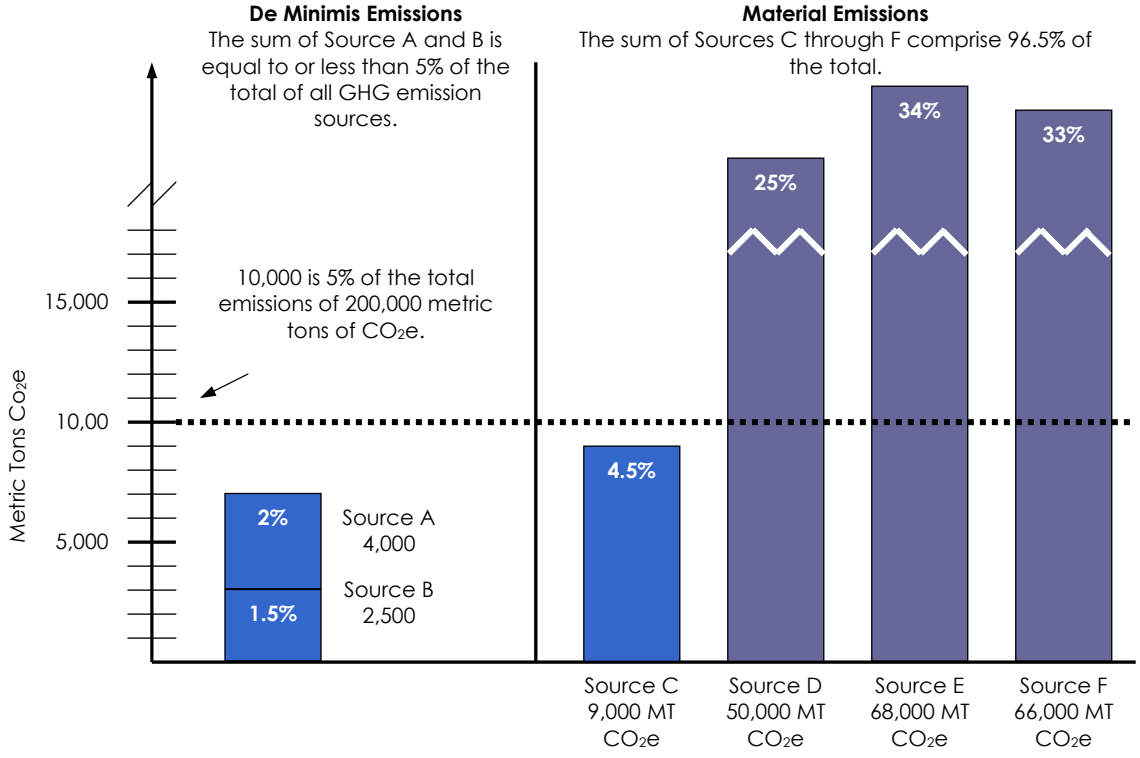
Figure 11-1. Example Where De Minimis Emissions Are 5% or Less.



Example 11-2. Materiality where De Minimis Emissions are Greater than Five Percent

Your company intends to report GHG emissions from 6 sources (Figure 11-2.). You have estimated that your total GHG emissions inventory from all 6 sources, including de minimis sources, is 200,000 metric tons of CO_2 e. Therefore, your 5% threshold is 10,000 metric tons of CO_2 e. You have three sources, Source A, Source B, and Source C, that are each below the 5% threshold. However, you will need to select a combination of sources that, when added together, are less than or equal to the 5% threshold. For example, you may choose to classify Source A and Source B as de minimis and therefore include Source C in your annual report, as shown in Figure 11-2. Likewise, you could also choose to classify Source C as de minimis and include Source A and Source B in your annual report.

Figure 11-2. Example Where De Minimis Emissions are Over 5%.



Example 11-3. Materiality where Different Sources of CO_2 and CH_4 Emissions are De Minimis

Your company plans to report both carbon dioxide and methane emissions from four sources. You have estimated your total GHG emissions from all four sources at 100,000 metric tons of CO_2 e. The emissions from the four sources are as follows:

Table 11-1. Materiality Example for Four Sources

Source	CO_2 Emissions (metric tons)	CH_4 Emissions (metric tons CO_2e)	Total Source Emissions (metric tons CO_2e)
Source 1	39,900	100*	40,000
Source 2	29,900	100*	30,000
Source 3	19,900	100*	20,000
Source 4	3,000*	7,000	10,000
		Total	**100,000**
		De Minimis Threshold	**5,000**

* De minimis emissions.

With 100,000 in total emissions, your 5% threshold is 5,000 metric tons of CO_2 equivalent. The CO_2 emissions from Source 1, Source 2, and Source 3 are material as they are each above the 5% threshold. Similarly, the methane emissions from Source 4 are above the threshold, and will need to be included in the emissions report. On the other hand, the methane emissions from Source 1, Source 2, and Source 3 (100 metric tons of CO_2 equivalent each), combined with the CO_2 emissions from Source 4, are below the 5% threshold, therefore would be considered de minimis (i.e., 100 + 100 +100 + 3,000 = 3,300 metric tons of CO_2 equivalent).

Chapter 12 Reporting Your Emissions

A B C D	Chapter 12 applies to all participant categories.
What you will find in Chapter 12	This chapter provides guidance on submitting your Emission Report to and accessing your report from the Registry.
Information you will need	In order to submit your GHG Emission Report, you will need a password from the Registry, as well as all the relevant information required in your report.
Cross-References	It may be useful to review the requirements in Part I for the Registration Process, as well as the General Reporting Protocol Road Map. In addition, it may be useful to review the requirements in Chapter 13 on Certification.

Overview

Now that you have established your reporting parameters in Part II, quantified your emissions in Part III, and determined your de minimis emissions, you are ready to report your emissions to the Registry using the CARROT online reporting tool.

See Chapter 13
Certification

Registration. If you have not already done so, you will need to review Part I - Introduction, that describes the Registration Process from Start to Finish. That section will take you step-by-step through the process of submitting your certified Emission Report to the Registry via the Registry's online reporting tools.

See Part I
Registration Process

Submitting Your Report Using the CARROT

Online Reporting

You should report your organization's annual GHG Emission Report via the Registry's web-based reporting application suite and database, known as the Climate Action Registry Reporting Online Tool (CARROT). CARROT provides you with a secure, on-line workspace to manage, report, certify, and register your emissions. The Registry has designed the CARROT to facilitate and ease emissions reporting. CARROT is also designed to streamline your registration process by providing emissions calculations tools, simple reporting features, and administrative controls that allow participants to delegate reporting within your organization.

CARROT Website
www.climateregistry.org

CARROT Guidance and Technical Assistance

In the event that you have questions about using the CARROT, the Registry provides reporting assistance and support through the following on-line tools:

- "Getting Started with CARROT" Guide, available online in PDF format;
- CARROT on-line help, and on-line documentation;
- CARROT frequently asked questions;
- Email user support, **help@climateregistry.org**; and
- Phone user support (1-877-CO2-CCAR).

Registry Technical Assistance
1-877-CO2-CCAR

CARROT Website
www.climateregistry.org

Prospective participants and other interested parties can get a better understanding of how CARROT can work for them by accessing an abbreviated demonstration of CARROT on the Registry's website (**www.climateregistry.org**).

Accessing Your Certified Emissions Data

Regardless of future emissions policies, the Registry's web-based emissions database and application suite, CARROT, will provide you with a variety of tools to help you manage and use your emissions data. The following are some of the features that will assist you in managing your reported GHG emissions information.

Participant Database Query and Reporting

This feature will allow you to query for certain reported data, and download data in Microsoft Excel over the Internet to your computer's desktop. Some examples of general CARROT reports include the following:

Reports for Participants
- Total Reported Emissions- Entity
- Entity-level Emissions by Year
- Total Reported Emissions – by Facility (if applicable)
- Facility Administrative Summary (if applicable)
- Total Reported Emissions – by Source (if applicable)

In addition to giving you direct access to your GHG emissions data, CARROT will also make limited information about your GHG Emission Report and overall Registry participation available to the public.

Reports Available to the Public
- Entity-level Emission Report
- California and US Total Reported Emissions
- California and US Total Reported Emissions by Industry
- List of Participants

Archive Feature

CARROT includes an archive feature that maintains all the versions of your GHG Emission Report submissions, with comments, in order to enable you to correct your submissions, and for Registry-approved Certifiers to certify your data.

Participant's Administrative Module

This feature allows you to manage separate emissions submissions, if necessary, from within your organization, depending on how many individuals are responsible for reporting a subset of your total GHG Emission Report. For example, if your organization owns and operates five

different facilities, the Participant Administrator can assign permission to five different Facility Managers to allow them to enter the GHG emissions information from each of their respective facilities. The Participant Administrator will be able to visually assess the status of each of the five facilities by viewing a CARROT work flow report, and will be the only party with the permission to submit and classify the entity emissions report as "Certification Ready."

Utilizing Your Certified Emissions Data

While the Registry cannot predict the full range of ways you can utilize your certified emissions data, there are some important uses that are worth considering. For example, once you have started entering your information in the Registry's CARROT reporting system, you will be able to maintain and track your organization's progress in meeting internal GHG reduction targets with every annual GHG Emission Report.

As mentioned earlier, under a possible future regulatory regime your certified emissions data could provide the basis for any determination of protections or other regulatory rewards for taking early steps to reduce your GHG emissions. Such possible future regulations by the State of California or the Federal government might reward those organizations taking significant steps to reduce GHG emissions with tradable credits for actions that may have taken place years before the regulations have taken effect, or lessened restrictions on allowable GHG emissions. Similarly, your GHG emissions data might be applicable for participating in private GHG emissions trading programs already in operation, both in the United States and abroad.

Given the possibility that a new ISO standard for GHG emission reduction practices might be developed, your emissions data, quantification experience, and related management actions might go toward helping your organization receive ISO certification.

In addition, you may publish your certified emissions data in order to demonstrate your organization's commitment to environmental goals and to addressing climate change, and to disseminate transparent information about the specific steps your organization has taken to achieve reductions in GHG emissions.

Chapter 13 Certification

A B C D	Chapter 13 applies to all participant categories.
What you will find in Chapter 13	This chapter provides guidance on the process for certifying your GHG Emission Report, including how to obtain certification services from an approved certifier, and what you will need to prepare for certification.
Information you will need	Chapter 13 will guide you through the steps involved in determining what information you will need for certification. Table 13-1 in this chapter provides a list of specific documentation that will be needed for certification.
Cross-References	All other chapters in the General Reporting Protocol may be considered during the certification process. In addition, you may consider reviewing the Certification Protocol, to be used by approved certifiers, in preparing for certification (available on the Registry's website at **www.climateregistry.org**.)

Overview

This General Reporting Protocol is designed to direct the complete, transparent, and accurate reporting of your organization's GHG emissions. Certifying your Emission Report is the final step in the reporting process.

Certification is the process used to ensure that a participant's GHG Emission Report (either baseline or annual result) has met a minimum quality standard and complied with an appropriate set of Registry-approved procedures and protocols for submitting emissions inventory information. For most Registry participants, meeting the requirements of the General Reporting Protocol should be sufficient to complete certification.

The Registry's certification process has been designed to promote the credibility, accuracy, transparency, and usefulness of emissions data reported to the Registry. Once an approved certifier has determined that the Emission Report meets a minimum quality standard and is free of material misstatement, that participant's reported emissions data will be accepted into the Registry's database.

Note, if you are interested in understanding and preparing for the certification process in more detail, and to see the specific process approved certifiers will be using to certify your GHG Emission Report, you may obtain a copy of the Certification Protocol from the Registry's website, at **www.climateregistry.org**.

Certification Protocol
Available on Registry website
www.climateregistry.org

Principles of Certification

The purpose of certification is to provide an independent review of data and information being submitted to the Registry to ensure that they meet certain quality criteria. To fulfill this purpose, the independent certification process maintains the criteria of completeness, consistency, accuracy, comparability and transparency as its underlying principles.

Completeness. Certification should ensure accounting of all material GHG emissions sources and activities within the specified scope of the participant's inventory. Baseline and annual emissions results should include all sources that are not de minimis in quantity and vertical and horizontal integration should be properly accounted for.

Consistency. An Emission Report should allow for meaningful comparison of emissions performance over time. Independent certification should ensure that consistent methodologies and measurements are used between the baseline results and annual emissions results. Additionally, changes to participant emission baselines are certified to ensure appropriate comparisons.

Comparability. A certified Emission Report should be comparable across similar organizations reporting to the Registry. The report should allow comparison of direct and indirect emissions against those of other reports with similar geographic and organizational scopes.

Accuracy. Entity-wide reported data should be within the materiality threshold of 5% of the certifier's estimate of total emissions. Calculations and estimates need to be as accurate and as precise as possible to prevent material errors.

Transparency. Certification should be a transparent exercise itself. Certification activities should be clearly and thoroughly documented to allow the possibility for outside reviews by the CEC or the Registry.

Certification Standard

Approved certifiers must certify participants' GHG Emission Reports against the Registry's General Reporting Protocol using the process outlined in this Certification Protocol. If a participant is reporting process or fugitive emissions, a separate industry specific protocol may also be used and cited. Some participants may wish to use their GHG Emission Report for additional purposes such as, registering in another registry, participating in emissions trading schemes, crediting programs, etc., and thus may add additional standards for certification.

Minimum Quality Standard

An Emission Report submitted to the Registry must be free of material misstatements to be certified. For a report to be free of material misstatements it must achieve a level of at least 95% accuracy. It is possible that during the certification process differences will arise between the emissions totals estimated by participants and those estimated by certifiers. Differences of this nature may be classified as either material (significant) or immaterial (insignificant). A discrepancy is considered to be material if the overall reported emissions differ from the overall emissions estimated by the certifier by 5% or more. A difference is immaterial if it is less than 5%.

Conflict of Interest

In order to ensure the credibility of the emissions data reported to the Registry and its potential utility under any future regulatory regime, it is critical that the certification process be viewed as completely independent from the influence of the participant submitting the Emission Report. Therefore, certifiers may not engage in both consulting and certification services with the same client. Because even the appearance of a conflict of interest can impair the integrity of the data in the Registry database, this prohibition applies to not only

technical assistance related to GHG emissions estimation, but to any and all consulting services. ***A certifier may not engage in certification services with a participant if the certifier's firm has provided consulting services of any kind to that client within the previous three years.***

In the event that a certifier violates these conditions, the Registry, in consultation with the CEC, and at its discretion, may disqualify an approved certifier for a period of up to five years.

This conflict of interest clause does not preclude a certifier from engaging in consulting services for other clients that participate in the Registry for whom the certifier does not provide any certification activities.

Reporting Uncertainty vs. Inherent Uncertainty

When evaluating participants' Emission Reports, certifiers should concentrate on determining if the reporting uncertainty (vs. the inherent uncertainty) is less than the minimum quality standard. Reporting uncertainty entails the mistakes made in identifying emissions sources and managing and calculating GHG emissions. Inherent uncertainty refers to scientific uncertainty associated with measuring GHG emissions. The Registry is aware that there is inherent uncertainty in emissions factors and measurement of activity data through metering and instrumentation (even after the calibration of meters and other data collection methods are certified as accurate), but determining scientific accuracy is not the focus of the Registry or its General Reporting Protocol.

Certification Deadlines

Although there is no deadline for submitting your GHG Emission Report, certification should be *initiated* by December 31 of the year you submit your report to the Registry. In addition, the certification process should be *completed* within one calendar year of the date when you submitted the Emission Report to the Registry. In other words, if you submit a GHG Emission Report for 2002 emissions on April 1, 2003, the certification process should begin by December 31, 2003 and *end by* March 31, 2004.

Requirement for Comprehensive Certification

While the Registry envisions a more streamlined and expedited review process in years two and three of each three year certification cycle, it is expected that certifiers will conduct a comprehensive review any time your organization reports an entity-wide change in GHG emissions that exceeds 10% of total reported emissions.

Key Questions

Certification Deadlines: *What is the deadline for completing the certification process?*

While there is no deadline for submitting an Emission Report, certification should be initiated by December 31 of the year your GHG Emission Report is submitted (e.g. certification of 2002 emissions data reported in 2003, must begin by December 31, 2003) and should be completed within one calendar year of the date when you submitted the Emission Report to the Registry.

Certification Costs
Contact the Registry or Approved Certifiers
1-877-CO2-CCAR
or
help@climateregistry.org

Costs: *What will it cost to have my GHG Emission Reports certified?*

Because certifiers will review GHG Emission Reports with more scrutiny every fourth year (barring significant changes to your geographic or organizational boundaries), costs associated with certification are likely to be higher in the first year than in years two or three of the reporting process. In order to obtain an estimate for certification, you will need to convey information about your: industrial sector, organization size (annual revenue and number of employees), number of facilities, estimated number and type of direct emissions sources, types of indirect emission sources (e.g., electricity from a utility, or electricity or heat from co-generation), the types of gases you are reporting, and the methodologies you are using to estimate and report your emissions (e.g., utilization of the CARROT online reporting tool).

You may contact the Registry for information about the costs associated with certifying your GHG Emission Report at **1-877-CO2-CCAR**. In addition, you may contact Registry-approved certifiers listed on the Registry's website at **www.climateregistry.org** for information about the estimated costs associated with certification.

"Batch Certification": *What is it? How does it work? How will it affect bidding, contracting, and the overall certification process?*

Call for Information
Batch Certification
1-877-CO2-CCAR

In an effort to minimize transaction costs, Registry participants who have only indirect emissions from electricity consumption and direct emissions from stationary combustion at a single site, and/or direct emissions from five or less vehicles may request to participate in "batch certification" with similar organizations through the Registry. In that situation, bidding, contract negotiations, and the kick-off meeting will take place between the certifier and the Registry. Standard terms and conditions are expected to apply for all contract elements. The Registry will initiate the procurement process for batch certification. For more information about batch certification, contract the Registry at **1-877-CO2-CCAR**.

Certification and Remediation: *What if my GHG Emission Report is not certified?*

See Part IV
Completing a Certification Report

At the completion of the certification process, the certifier will prepare a Certification Report and forward it to the responsible official representing the Registry participant. (The responsible official includes anyone authorized by the participant to approve the GHG Emission Report for submission to the Registry and will typically be a corporate official or the technical manager of the certification contract.)

If the certifier identifies material misstatements that prevent a clean Certification Opinion, those material misstatements should be listed and described in the Certification Report. If possible, the participant may correct those material misstatements and resubmit the Emission Report for certification within a reasonable amount of time. The participant may retain technical assistance to correct material misstatements but *the certifier may not provide such technical assistance as it would create a conflict of interest*.

If the participant is unable to correct the material misstatements, the Registry will retain the participant's data in the Registry database for up to two years pending certification. Participants who have submitted a report and undergone certification as part of a "learning by doing" process may wish to retain a pending status for their Emission Report for up to two years while the report is enhanced.

Certification Report and Certification Opinion: *What are the Certification Report and Certification Opinion and how are they different?*

The **Certification Report** is a detailed report that a certifier prepares for a participant. The report should describe the scope of the certification process, standards used, emissions sources identified, sampling techniques, evaluation of the participant's compliance with the General Reporting Protocol, and list material and immaterial misstatements, if any. The Certification Report is a confidential document between a certifier and participant, and is not shared with the Registry or the public.

This Chapter
Certification Report and Opinion

The **Certification Opinion** is a brief, one-page summary of a certifier's findings that simply states if a participant's Emission Report is certifiable or not. The Certification Opinion is submitted to both the participant and the Registry. A majority of the contents of the Certification Opinion will be available to the public.

Confidentiality: *Are the results of the certification kept confidential? Is emissions data kept confidential?*

The Registry will make public the Certification Opinion as well as the identity of your certifier, but not your Certification Report. All aggregated entity-level emissions data and metrics reported to the Registry will be available to the public. However, the Registry intends to keep confidential all reported emissions, activity data, methodologies, and emissions factors with a higher granularity (at facility, project, or source levels). Confidential information will only be accessible to the participant, the Registry, and the certifier, unless the participant allows others access to such information or wishes to have it available to the public.

Preparing for Certification

The pre-certification process involves several steps, including:

- identifying prospective certifiers on the Registry's website;
- executing a competitive bid process or awarding a sole source contract for certification services, or, if you are eligible, participating in "batch certification" through the Registry;
- negotiating your contract with your selected certifier; and
- assembling relevant materials needed by the certifier to certify your emissions data.

Use of Registry-Approved Certifiers. You must choose your certifier from the list of approved certifiers maintained by the Registry. Information about Registry-approved certifiers is provided on the Registry website at **www.climateregistry.org**.

Request for Bids for Certification Services

Options for Soliciting Bids. The Registry recommends that those participants with complex GHG Emission Reports solicit competitive bids for certification services from at least three Registry-approved certifiers. If your organization has prepared a simpler GHG Emission Report and does not seek, or is not eligible for, "batch certification," you may wish to either secure competitive bids or to sole-source the certification contract in order to reduce costs and expedite the certification process.

Non-Disclosure Agreements. When preparing to send out a request for bids from certifiers, you should review the list of approved certifiers and select some or all as prospective bidders. The Registry recommends that you send the contact person from each prospective bidder a non-disclosure agreement prior to requesting bids or releasing potentially proprietary information.

The Request for Bids. In order to obtain the most competitive bids and ensure that you will receive the most effective certification services, your request for bids should include as much detailed information about your organization and its Emission Report as possible.

The Registry recommends that participants include the following information in their requests for bids from certifiers:

1. The expected contract duration;
2. A general description of the participant's organization;
3. The geographic boundaries of the participant's report;
4. The number and locations of facilities and operations;
5. The GHGs reported in the participant's Emission Report;
6. The emission source categories (and possibly emission sources) in the participant's report; and
7. The password to a read-only version of the participant's Emission Report in CARROT.

You should request bids and negotiate terms and conditions for a complete certification, including:

- A review of your management systems (required in year one and recommended at least every third year thereafter);
- A review of your underlying activity data;
- Confirmation of emissions estimates:
- A final Certification Report;
- A Certification Opinion submitted to the Registry.

The Registry suggests that participants request Commercial and Technical Proposals from potential certifiers that include the following components:

Commercial Proposal

1. **History and Description of Company**
2. **Explanation of Core Competencies**

Technical Proposal

1. **Approach to Preparing for Certification**
2. **Approach for Completing Core Certification Activities**

See Part III
Core Certification Activities

3. **Proposed Price for Certification Services** 4. **Proposed Staff** 5. **Statement of Certifier Liability** 6. **Confidentiality Policy** 7. **Duration of Contract**	3. **Approach for Completing the Certification Process**

Negotiating a Contract with the Certifier

After you have selected from the approved certifiers from which you receive bids, you should negotiate complete contract terms. This contract is exclusively between the participant and the certifier, and the particulars of any given contract are at the discretion of the two parties. However, contracts for certification services typically include the following components:

See Chapter 2
Organizational Boundaries

- **Scope of the Certification Process.** This component of the contract will outline the exact geographic and organizational boundaries of the participant's emissions inventory to be examined. This should, but may not necessarily, match the boundaries used in the GHG Emission Report to the Registry. This scope will indicate whether California-only emissions are included or if both California and U.S. emissions are included. It will also include whether the participant has used the management control, equity share, or other method based on contractual relationships to determine organizational boundaries.

- **Confirmation of Approved Certifier Status.** This is a simple statement that the certifier has been approved by both the CEC and the Registry to certify Emission Reports covering the scope listed above.

- **Certification Standard.** Approved Certifiers must certify participants' GHG Emission Reports against the Registry's General Reporting Protocol using the process outlined in this Certification Protocol. However, if a participant is reporting process or fugitive emissions, a separate industry specific protocol may also be used and cited. Some participants may wish to use their GHG Emission Report for additional purposes such as, registering in another registry, participating in an emissions trading scheme or crediting program, etc., and thus may add additional standards for certification.

- **Non-disclosure Terms.** The certifier and the participant should agree in advance on methods for identifying and protecting proprietary and business confidential data that may be revealed during certification.

- **Site Access.** The certifier and the participant should agree in advance to the time, place, and conditions of certifier's site visits, if any are required.

- **Documentation and Data Requirements.** The certifier and participant should agree on how and when the participant will provide emissions data to the certifier. The range of required documentation will largely be determined by the size and complexity of participant operations, and whether the participant has used the on line calculation tools available through CARROT.

- **Period of Performance.** The period of performance for certification services will typically be for three years, given that the certification process required by the Registry is more streamlined in Year 2 and Year 3, if participant operations do not change. However, there may be instances where contracts are negotiated for a single year, pending renewal.

- **Performance Schedule.** Participants and certifiers may wish to agree on a schedule to complete the certification process and for the certifier to deliver a Certification Report and Certifier's Opinion. Certification should be initiated by December 31 of the year the participant's data is submitted, and should be completed within one calendar year of when the Emission Report was submitted.

See Part IV
Sample Certification Opinion

- **Payment Terms.** Typical payment terms include total value, schedule of payments, and method of payment (e.g., electronic funds transfer).

- **Re-certification Terms.** If the certifier identifies material misstatements, the participant may choose to revise its GHG Emission Report. At that time, the participant may ask the certifier to re-certify the report or seek certification from another provider. *The certifier may not provide guidance, technical assistance, or implementation work on the remediation of material misstatements, as this would be viewed as consulting services and result in a conflict of interest.*

- **Liability.** All certifiers are subject to the minimum liability associated with completing the certification per the terms of the certification contract. The participant may require and the certifier may agree to additional liability under this contract.

See Part I
Key Issues, Liability

- **Contacts.** The contract should identify technical leads for the participant and certifier, as well as responsible corporate officials of each party.

Certifier Requirement to Notify Registry of Certification

After you and the certifier have negotiated complete contract terms, but at least two weeks (10 business days) prior to beginning of certification activities, *the certifier* is required to notify both the Registry and the CEC of any and all planned certification activities. This notification period is necessary to allow the CEC the opportunity to occasionally accompany certifiers on visits to participants' sites. The CEC is required to observe, evaluate, and report on the quality and consistency of certification activities. A certifier that does not provide proper notification to the Registry and the CEC may be disqualified as an approved certifier.

Kick-off Meeting

After you and the certifier have finished negotiating contract terms, and the certifier has notified the Registry and CEC of planned certification activities, certifiers should host a kick-off meeting with participants. The agenda for that meeting should include:

1. Introduction of the certification team;

2. Review and confirmation of certification process and scope;

3. Transfer of background information and underlying activity data (See Table 13-1); and

4. Review and confirmation of the certification process schedule;

Based on the information provided in agenda items 2 and 3, the certifier should determine the most effective, efficient, and credible detailed certification approach tailored to the particular characteristics of the participant.

The Certification Process

The certification process outlined in the companion Certification Protocol is designed to be applied consistently across all participants. However, based on the size and complexity of participants' operations and management systems, certification activities and the duration of the process will vary.

In short, approved Certifiers must certify participants' GHG Emission Reports against the Registry's General Reporting Protocol using the process outlined in this Certification Protocol. While the specific certification activities will differ based on the length and complexity of a participant's Emission Report, the certification process will include the following steps:

- Scoping and planning a participant's certification activities
- Conducting certification activities
    1. Identifying emissions sources
    2. Reviewing methodologies and management systems
    3. Verifying emission estimates
- Preparing a participant's Certification Report and Certification Opinion
- Submitting a participant-authorized Certification Opinion to the Registry

Upon the completion of the above steps, the Registry will accept a participant's certified data into its emissions database.

Online Reporting

If a participant chooses to use the Registry's on-line calculation tool (the CARROT) and the certifier's document review suggests that data have been collected properly and entered accurately, the certifier will not need to re-calculate the emissions, as the calculations will be automatic. Due to the time savings, this should result in a less expensive and expedited certification process.

Documentation for Review

The documents that will need to be reviewed during certification will also vary depending on the nature of the emission sources contained in you GHG Emission Report to the Registry. Table 13-1 on the following page, provides a list of recommended documents to have ready to provide a certifier for conducting the certification process.

Table 13-1. Recommended Documents to be Reviewed During Certification Activities	
Activity or Emissions Source	**Documents**
Identifying Emission Sources	
Emission Source Inventory	Facility Inventory
	Emission Source Inventory Stationary Source Inventory Mobile Source Inventory Fuel Inventory
Understanding Management Systems and Methodologies	
Responsibilities for Implementing GHG Management Plan	Organization Chart, Greenhouse Gas Management Plan, Documentation and Retention Plan
Training	Training Manual, Procedures Manual, Consultant Quals Statement
Methodologies	Protocols Used (if in addition to the Registry's General Reporting Protocol)
Verifying Emission Estimates	
Indirect Emissions from Electricity Use	Monthly Electric Utility Bills, Emission Factors (if not default)
Direct Emissions from Mobile Combustion	Fuel Purchase Records, Fuel in Stock, Vehicle Miles Traveled, Inventory of Vehicles, Emission Factors (if not default)
Direct Emissions from Stationary Combustion	Monthly Utility Bills, Fuel Purchase Records, CEMs Data, Inventory of Stationary Combustion Facilities, Emission Factors (if not default)
Indirect Emissions from Cogeneration	Monthly Utility Bills, Fuel and Efficiency Data from Supplier, Emission Factors (if not default)
Indirect Emissions from Imported Steam	Monthly Utility Bills, Fuel and Efficiency Data from Supplier, Emission Factors (if not default)
Indirect Emissions from District Heating	Monthly Utility Bills, Fuel and Efficiency Data from Supplier, Emission Factors (if not default)
Indirect Emissions from District Cooling	Monthly Utility Bills, Fuel and Efficiency Data from Supplier, Emission Factors (if not default)
Direct Emissions from Manufacturing Processes	Raw Material Inputs, Production Output, Calculation Methodology, Emission Factors
Direct Fugitive Emissions	
Refrigeration Systems	Refrigerant Purchase Records, Refrigerant Sales Records, Calculation Methodology, Emission Factors
Landfills	Waste in Place Data, Waste Landfilled, Calculation Methodology, Emission Factors
Coal Mines	Coal Production Data Submitted to EIA, Quarterly MSHA Reports, Calculation Methodology, Emission Factors
Natural Gas Pipelines	Gas Throughput Data, Calculation Methodology, Emission Factors
Electric Transmission and Distribution	Sulfur Hexafluoride Purchase Records, Calculation Methodology, Emission Factors

Participant Classes

To guide certifiers in their determination of appropriate certification activities, the Registry divides participants into three classes based on the level of effort necessary to certify their emissions. The characteristics of the certification approach for each of these classes are listed below. Of course, certifiers are expected to use their professional judgment to augment or narrow these approaches based on uncertainty in emissions estimates and other items affecting material accuracy.

Class I – Very Small Participants with Simple Operations. This class includes those participants who have only the following material emissions sources:

- indirect emissions from electricity consumption at a single site;
- direct emissions from stationary combustion at a single site; and/or
- direct emissions from five or less vehicles.

In an effort to minimize certification costs, Class I participants may elect to be batch certified with similar organizations by the Registry. In that case, bidding, negotiating of contracts will take place between the certifier and the Registry. Standard terms and conditions will apply for all contract elements. Class I certification will usually not require a site visit, but rather, activities will be conducted via the phone.

Class II – Larger Participants with More Complex Operations. This class includes those participants with only the following material emissions sources;

- indirect emissions from electricity consumption at more than one site;
- direct emissions from stationary combustion at more than one site;
- direct emissions from more than five vehicles; and/or
- no material process or fugitive emissions.

For Class II participants, at least one site visit (unless deemed unnecessary by the certifier) will be required. See Table 4 for guidelines for determining how many site visits are appropriate for various sized entities. Additional visits may be required if any characteristics of the participant changed (e.g., new sites, changed location, began new operations). Site visits are used to ensure that all material GHG emission sources have been included and appropriately accounted for, and to gain a better understanding of the participant's operations and characteristics.

Class III – Participants with Process or Fugitive Emissions. For participants with material process or fugitive emissions or other emissions not covered under Class II, certification activities must be more detailed. Because these emission sources are not currently explicitly covered in the General Reporting Protocol, additional professional judgment is required.

Core Certification Activities

The certification process is designed to ensure that there has been no material misstatement of your reported entity-wide inventory. In order to ensure consistency in the application of certification, the Registry provides all certifiers with a Certification Protocol that is based on the guidance contained in this Protocol (available on the Registry's website at **www.climateregistry.org**.) The Certification Protocol is a guidance document. However, since certifiers face potential financial liability for reports they have certified, it is the certifier's ultimate discretion whether to certify your report.

Once the certifier has completed the preparations for certification including the kick-off meeting and the selection of a general approach to certification, the core certification activities can begin. If the same certifier has been retained for a second or third year of certification services and the participant's entity-wide emission inventory has not changed by more than 10% year over year, the certifier may move directly to these core certification services.

The core certification activities include three primary elements:

1. Identifying emissions sources;
2. Understanding management systems and estimation methods used;
3. Verifying emission estimates.

The core certification activities are fundamentally a risk assessment and data sampling effort aimed at ensuring that no material sources are excluded and that the risk of error is assessed and addressed through appropriate sampling and review. The complete core certification process is illustrated in Figure 13-1, below.

Figure 13-1. The Core Certification Process.

While certification is required annually, in some instances it can be thought of as a three-year process. In Year 1, a certifier will need to form a detailed understanding of a participant's operations and consequential GHG emissions. Assuming that there have been no significant changes in the geographic and organizational boundaries of a participant's operations, a certifier is likely to have identified all emission sources and gained a sufficient understanding of the participant's GHG emissions management systems in Year 1 to streamline and expedite the certification activities to focus on verifying emissions estimates in Year 2 and Year 3. To ensure data integrity, all of the core certification activities should be completed in Year 4.

Thus, the core certification activities each year will likely be as follows:

Year 1: Identify Emission Sources, Review Management Systems, Verify Emissions Estimates

Year 2: Verify Emissions Estimates

Year 3: Verify Emissions Estimates

Year 4: Same as Year 1

The Registry assumes that Certifiers will use their best professional judgment when conducting certification activities, and thus, will modify the suggested annual process described above as necessary.

Certification Report and Opinion

The certifier should prepare a detailed Certification Report that, when cleared through internal review process, will be forwarded to the appropriate body within the participant's organization. The Certification Report is a confidential document that is shared between a certifier and a participant—it is not available to the Registry or the public.

Certification Report

The Certification Report should include the following elements:

- The scope of the certification process undertaken;
- The standard used to certify emissions (this is the Registry's General Reporting Protocol, but may also include other protocols or methodologies for those sources for which the Registry has yet to provide detailed guidance);
- A description of the certification activities, based on the size and complexity of the participant's operations;
- A list of emissions sources identified;
- A description of the sampling techniques and risk assessment methodologies employed for each source;
- An evaluation of the participant's Emission Report compliance with the Registry's General Reporting Protocol;
- A comparison of the participant's overall emission estimates with the certifier's overall emission estimates;
- A list of material misstatements, if any; and
- A list of immaterial misstatements, if any;
- A general conclusion to be reflected in the Certification Opinion forwarded to the Registry.

After the Certification Report has been completed and approved by an independent senior reviewer within the certifier's firm, it should be forwarded to the appropriate official at the participant's organization. That official should be provided up to 30 days to review and comment on the certification report. At the end of that review, the certifier and the appropriate official at the participant's organization should hold a meeting to discuss the nature of any material or immaterial misstatements.

Certification Opinion

The Certification Opinion is a simple confirmation of the certification activities and outcomes for all stakeholders (participants, certifiers, the Registry, and the public). The Certification Opinion must also follow the same internal review process as the Certification Report, and

consequently must be reviewed and signed by an independent senior reviewer within the certifier's firm.

Exit Meeting

Certifiers should prepare a brief summary presentation of their certification findings for the participant's key personnel. At the exit meeting certifiers and participants might exchange lessons learned about the certification process and share thoughts for improving the certification process in the future. Certifiers and participants may wish to consider joint feedback to the Registry.

The goals of this meeting should be:

- Acceptance of the Certification Report and Opinion (unless material misstatements exist and can be remediated, in which case the certification contract may need to be revised, and a recertification scheduled). If the participant does not wish to retain the certifier for the re-certification process, the certifier shall turn over all relevant documentation to the participant within 30 days.
- Authorization for the certifier to submit the Certification Opinion to the Registry and complete the certification form in the CARROT

Submitting a Certified Emission Report to the Registry

Once a participant authorizes the Certification Opinion, the certifier must complete the electronic certification form in the CARROT (**www.climateregistry.org**) and send the original Certification Opinion to the Registry at the address listed below:

Technical Director
California Climate Action Registry
515 S. Flower Street, Suite 1305
Los Angeles, CA 90071

Once the electronic certification form is completed and the Registry receives a hardcopy of the Certification Opinion, the participant's report will be formally accepted into the Registry database, and the annual certification process will be completed.

* Note: Participants are *not* required to submit their Certification Opinions to the Registry for the first two years of their participation. However, it is important to note that a participant's emissions data will not be considered accepted by the Registry unless the Registry receives a Certification Opinion indicating a "certified without qualification" assessment.

Congratulations! At this point the annual certification process is complete.

Record Keeping and Retention

See This Chapter
Table 13-1
Documents for Review

You should maintain any relevant records from which emissions results have been calculated. Such records may include, but not be limited to, utility bills, fuel consumption records, emissions data, process data and schedules, and past reports. Although it is not possible to predict what any future regulatory regime may require regarding record keeping and retention, it is impractical to require you to retain records indefinitely. It is, however, inadvisable for you to dispose of relevant records immediately after filing Emission Reports.

This would hinder any future certification or review activities, placing you at a disadvantage in case of some need to re-estimate the emissions results. In addition, your baseline inventory data is the key to determining temporal trends in GHG emissions

Correcting Your GHG Emissions Report

After you have submitted your certified GHG Emission Report to the Registry, you will still be able to make corrections if you have determined an error in your report, have identified new emissions sources, or would like to utilize more thorough calculation methodologies to estimate your emissions. You should note that the Registry's reporting system is designed to retain all original reports and records it receives as archives, even after a GHG Emission Report has been corrected or updated. Please contact the Registry's technical staff to discuss modifying your Emission Report at 877-CO2-CCAR.

Registry Technical Assistance:
1-877-CO2-CCAR

Once you have updated your GHG Emission Report, the portion you have updated will need to be certified by a Registry-approved certifier, following the process described in this chapter. Note that if the specific changes you have made to your report influence or affect the estimations of other elements of your report, you will again need to have the certifier review and certify all relevant sections of your GHG Emission Report. Unless your overall corrections result in a material (significant) change in emissions from your previous GHG Emission Report, certification should require no more than the typical "off-year" certification process involved in years two and three of the three-year reporting cycle.

For more information and guidance on correcting your GHG Emission Report, contact the Registry at **1-877-CO2-CCAR**.

Appendix A Glossary

Barrel (bbl)

Commonly used to measure quantities of various petroleum products, a volumetric measure for liquids equal to 42 U.S. gallons at 60 degrees Fahrenheit.

Baseline

For the purposes of this Protocol, a datum against which to measure GHG emissions performance or change over time, usually annual emissions in a selected base year.

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.

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.)

CO_2-equivalent (CO_2e)

A measure for comparing carbon dioxide with other GHGs (which generally have a higher global warming potential (GWP)), based on the amount of those other gases multiplied by the appropriate GWP factor; commonly expressed as metric tons of carbon dioxide equivalents ($MTCO_2e$). CO2e is calculated by multiplying the metric tons of a gas by the appropriate GWP.

Carbon Intensity

The relative amount of carbon emitted per unit of energy or fuels consumed.

Certification

For the purposes of this Protocol, the method used to ensure that a given participant's GHG emissions inventory (either the baseline or annual result) has met a minimum quality standard and complied with an appropriate set of Registry-approved procedures and protocols for submitting emissions inventory information.

Certifier

For the purposes of this Protocol, an organization approved by the Registry and the California Energy Commission to provide certification services for Registry participants.

Cogeneration

The generation of two forms of energy such as heat and electricity from the same process with the purpose of utilizing or selling both simultaneously.

Datum

A reference or starting point.

De Minimis

For the purposes of this Protocol, the GHG emissions from one or more sources, for one or more gases which, when summed, equal less than 5% of an organization's total emissions.

Direct Emissions

For the purposes of this Protocol, emissions from applicable sources that are owned or controlled by the reporting organization.

Emission Factor

A unique value for determining the weight of a GHG emitted for a given quantity of fossil fuel consumed or combusted (e.g., million metric tons of carbon dioxide emitted per barrel of fossil fuel consumed).

Equity Share

According to the calculated share.

Fugitive Emissions

The unintended or incidental emissions of greenhouse gases from the transmission, processing, or transportation of fossil fuels or other materials, such as HFCs from refrigeration leaks, SF_6 from electrical power distributors, methane emissions from solid waste landfills, and other sources.

Global Warming Potential (GWP)

The ratio of radiative forcing that would result from the emission of one kilogram of a GHG to that from the emission of one kilogram of carbon dioxide over a fixed period of time.

Higher Heating Value (HHV)

The amount of heat released from the complete combustion of a fuel including water vapor produced in the process.

Hydrocarbons

Chemical compounds containing only carbon and hydrogen, including fossil fuels and a variety of major air pollutants.

Hydrofluorocarbons (HFCs)

One of the six primary GHGs primarily used as refrigerants, consists of a class of gases containing hydrogen, fluorine, and carbon, and possessing a range of high and very high GWP values from 120 to 12,000.

Indirect Emissions

Emissions that occur because of a participant's actions, but are produced by sources owned or controlled by another entity.

Intergovernmental Panel on Climate Change (IPCC)

An organization established jointly by the United Nations Environment Programme and the World Meteorological Organization in 1988 to assess information in the scientific and technical literature related to all significant components of the issue of climate change, and providing technical analysis of the science of climate change as well as guidance on the quantification of GHG emissions.

Joule

A measure of energy, representing the energy needed to push with a force of one Newton for one meter.

Lower Heating Value (LHV)

The amount of heat released from the complete combustion of a fuel after netting out the heat that is released with the water vapor produced in the process.

Management Control

The ability of an entity to govern the operating policies of another entity or facility so as to obtain benefits from its activities.

Material

Any emission of GHG that is not de minimis in quantity.

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.)

Methane (CH_4)

One of the six primary GHGs, consisting of a single carbon atom and four hydrogen atoms (CH_4), possessing a high 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

Common international measurement for the quantity of GHG emissions, equivalent to about 2,204.6 pounds or 1.1 short tons.

Nitrous Oxide (N_2O)

One of the six primary GHGs, consisting of a two nitrogen atoms and a single oxygen atom (N_2O), possessing a high 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.

Perfluorocarbons (PFCs)

One of the six primary GHGs, consists of a class of gases containing carbon and fluorine (represented by the chemical formula $C_NF_{(2N+2)}$), originally introduced as alternatives to ozone depleting substances and typically emitted as by-products of industrial and manufacturing processes, and possessing very high GWPs ranging from 5,700 to 11,900.

Short Ton

Common measurement for a ton in the U.S. and equivalent to 2,000 pounds or about 0.907 metric tons.

Sulfur Hexafluoride (SF_6)

One of the six primary GHGs, consisting of a single sulfur atom and six fluoride atoms (SF_6), possessing a very high GWP of 22,000, and primarily used in electrical transmission and distribution systems.

Therm

A measure of one hundred thousand (10^5) Btus.

Appendix B Common Conversion Factors

Energy

1 quadrillion Btu	=	1.0551×10^{18} joules
	=	1.0551 exajoules
	=	10^{9} MMBtu
1 MMBtu (million Btu)	=	1.0551×10^{12} joules
	=	1.0551×10^{-6} exajoules
	=	10^{-5} Therm
1 joule	=	947.9×10^{-21} quadrillion Btu
1 exajoule	=	10^{18} joules
	=	0.9479 quadrillion Btu
1 GJ (gigajoule)	=	947,817 Btu
	=	277.8 kWh (kilowatt hours)
	=	0.2778 MWh (Megawatt hours)
1 Therm	=	10^{5} Btu

Mass

1 short ton (U.S. ton)	=	2,000 pounds (lbs)
	=	0.9072 metric tons
	=	9.072×10^{-4} grams
1 kilogram	=	2.20462 pounds (lbs)
1 metric ton	=	1.1023 short tons
	=	1.1023 tons (U.S.)
	=	2,204.62 pounds (lbs)
	=	1,000 kg
	=	10^{-3} kilotons
	=	10^{-6} megatons

Volume

1 cubic centimeter	=	3.531×10^{-5} cubic feet
1 cubic meter (m^3)	=	35.3115 ft^3 (cubic feet)
	=	1,000 liters
	=	264.2 U.S. gallons
	=	6.29 barrels
	=	1.308 yd^3 (cubic yards)
1 barrel	=	42 gallons
	=	5.6139 ft^3 (cubic feet)
	=	0.15898 m^3

= 158.98 liters

Area

1 acre	=	0.40468724 hectare (ha)
	=	4,047 m^2
1 hectare (ha)	=	35.3115 ft^3 (cubic feet)
	=	10,000 m^2
	=	2.47 acres

Distance

1 kilometer	=	0.6214 miles

Density

1,000 cubic feet of methane (CH_4)	=	42.28 pounds
1,000 cubic feet carbon dioxide (CO_2)	=	115.97 pounds
1 metric ton natural gas liquids	=	11.6 barrels
1 metric ton unfinished oils	=	7.46 barrels
1 metric ton alcohol	=	7.94 barrels
1 metric ton liquefied petroleum gas	=	11.6 barrels
1 metric ton aviation gasoline	=	8.9 barrels
1 metric ton naphtha jet fuel	=	8.27 barrels
1 metric ton kerosene jet fuel	=	7.93 barrels
1 metric ton motor gasoline	=	8.53 barrels
1 metric ton kerosene	=	7.73 barrels
1 metric ton naphtha	=	8.22 barrels
1 metric ton distillate	=	7.46 barrels
1 metric ton residual oil	=	6.66 barrels
1 metric ton lubricants	=	7.06 barrels
1 metric ton bitumen	=	6.06 barrels
1 metric ton waxes	=	7.87 barrels
1 metric ton petroleum coke	=	5.51 barrels
1 metric ton petrochemical feedstocks	=	7.46 barrels
1 metric ton special naphtha	=	8.53 barrels
1 metric ton miscellaneous products	=	8.00 barrels

Metric Prefixes

Abbreviation	Prefix	Multiple
k	kilo-	10^3 or 1,000
M	mega-	10^6 or 1,000,000
G	giga-	10^9 or 1,000,000,000
T	tera-	10^{12} or 1,000,000,000,000
P	peta-	10^{15} or 1,000,000,000,000,000

Appendix C Calculation References

Unadjusted Emission Factors for Electricity Use

See Chapter 5
Table 5-1
Adjusted Emission Factors for Electricity Use

Table C-1 provides **unadjusted emission factors** by state and region for electricity use. In contrast to Table C-1, Table 5-1 in the Protocol contains emission factors for electricity use that have been adjusted to include transmission and distribution losses estimated at 8%.

Table C-1 Average Electricity Emission Factors by State and Region

	Carbon Dioxide Emission Factor				
Region/ State	lbs/kWh	Short tons/MWh	Metric tons/MWh	Methane lbs/MWh	Nitrous Oxide lbs/MWh
Pacific Contiguous	**0.45**	**0.224**	**0.203**	**0.0053**	**0.0037**
California	0.61	0.303	0.275	0.0067	0.0037
Oregon	0.28	0.141	0.127	0.0033	0.0034
Washington	0.25	0.123	0.111	0.0037	0.0040
Pacific Non-contiguous	**1.56**	**0.780**	**0.707**	**0.0161**	**0.0149**
Alaska	1.38	0.690	0.626	0.0068	0.0089
Hawaii	1.66	0.831	0.754	0.0214	0.0183
Mountain	**1.56**	**0.781**	**0.709**	**0.0108**	**0.0236**
Arizona	1.05	0.525	0.476	0.0068	0.0154
Colorado	1.93	0.963	0.873	0.0127	0.0289
Idaho	0.03	0.014	0.013	0.0080	0.0033
Montana	1.43	0.717	0.650	0.0108	0.0227
Nevada	1.52	0.759	0.688	0.0090	0.0195
New Mexico	2.02	1.009	0.915	0.0131	0.0296
Utah	1.93	0.967	0.878	0.0134	0.0308
Wyoming	2.15	1.073	0.973	0.0147	0.0338
West-North Central	**1.73**	**0.864**	**0.784**	**0.0127**	**0.0269**
Iowa	1.88	0.941	0.854	0.0138	0.0298
Kansas	1.68	0.842	0.764	0.0112	0.0254
Minnesota	1.52	0.762	0.691	0.0157	0.0247
Missouri	1.84	0.920	0.835	0.0126	0.0288
Nebraska	1.40	0.700	0.635	0.0095	0.0219
North Dakota	2.24	1.121	1.017	0.0147	0.0339
South Dakota	0.80	0.399	0.362	0.0053	0.0121
West-South Central	**1.43**	**0.714**	**0.648**	**0.0087**	**0.0153**
Arkansas	1.29	0.643	0.584	0.0125	0.0203
Louisiana	1.18	0.589	0.534	0.0094	0.0112
Oklahoma	1.72	0.861	0.781	0.0110	0.0223
Texas	1.46	0.732	0.664	0.0077	0.0146
East-North Central	**1.63**	**0.815**	**0.740**	**0.0123**	**0.0257**
Illinois	1.16	0.582	0.528	0.0082	0.0180
Indiana	2.08	1.038	0.942	0.0143	0.0323
Michigan	1.58	0.790	0.717	0.0146	0.0250
Ohio	1.80	0.900	0.817	0.0130	0.0288
Wisconsin	1.64	0.821	0.745	0.0138	0.0260
East-South Central	**1.49**	**0.746**	**0.677**	**0.0128**	**0.0240**
Alabama	1.31	0.656	0.595	0.0137	0.0223
Kentucky	2.01	1.004	0.911	0.0140	0.0321
Mississippi	1.29	0.647	0.587	0.0132	0.0165
Tennessee	1.30	0.648	0.588	0.0105	0.0212
New England	**0.98**	**0.491**	**0.446**	**0.0207**	**0.0146**
Connecticut	0.94	0.471	0.427	0.0174	0.0120

Maine	0.85	0.426	0.386	0.0565	0.0270
Massachusetts	1.28	0.639	0.579	0.0174	0.0159
New Hampshire	0.68	0.341	0.310	0.0172	0.0141
Rhode Island	1.05	0.526	0.477	0.0068	0.0047
Vermont	0.03	0.014	0.013	0.0096	0.0039
Mid Atlantic	**1.04**	**0.520**	**0.471**	**0.0093**	**0.0145**
New Jersey	0.71	0.353	0.320	0.0077	0.0079
New York	0.86	0.429	0.389	0.0081	0.0089
Pennsylvania	1.26	0.632	0.574	0.0107	0.0203
South Atlantic	**1.35**	**0.674**	**0.612**	**0.0127**	**0.0207**
Delaware	1.83	0.915	0.830	0.0123	0.0227
Florida	1.39	0.697	0.632	0.0150	0.0180
Georgia	1.37	0.683	0.619	0.0129	0.0226
Maryland*	1.37	0.683	0.620	0.0118	0.0206
North Carolina	1.24	0.621	0.563	0.0105	0.0203
South Carolina	0.83	0.417	0.378	0.0091	0.0145
Virginia	1.16	0.582	0.528	0.0137	0.0192
West Virginia	1.98	0.988	0.897	0.0137	0.0316
United States	**1.34**	**0.668**	**0.606**	**0.0111**	**0.0192**

* Includes the District of Columbia.

Note: All emission factors for electricity generation were derived based on higher heating values (HHV).

Sources: Emission factors are derived from: Energy Information Administration, *Updated State-level Greenhouse Gas Emission Factors for Electricity Generation 1998-2002* (April 2002), **http://www.eia.doe.gov/oiaf/1605/techassist.html**. Note: These state-level electricity generation emission factors represent average emissions per kWh or MWh generated by utility and non-utility electric generators for the 1998-2000 time period. EIA's Voluntary Reporting of Greenhouse Gases (1605(b)) Program believes these factors provide reasonably accurate default values for power generated in a given state. However, reporters should use these state- and regional-level factors only if utility-specific or power pool-specific emission factors are not available.

Unadjusted Emission Information for Mobile Combustion

Table C-2 provides unadjusted emission information for mobile combustion. In contrast to Table C-2, Table 6-1 contains emission factors that have been adjusted to include the fraction of carbon oxidized.

See Chapter 6
Table 6-1
Adjusted Emission Factors for Mobile Combustion

Table C-2 Carbon Dioxide Emission Factor and Fuel Fraction Oxidized for Transport Fuels

Fuel	Carbon Dioxide Emission Factor		Fraction of Carbon Oxidized
	kg CO_2/MMBtu	kg CO_2/gallon	
Natural Gas	53.05	NA	99.5
Petroleum			
Aviation Gasoline	69.18	8.32	99.0
Distillate Fuel (Diesel)	73.15	10.15	99.0
Jet Fuel, Kerosene	70.88	9.57	99.0
Jet Fuel, Naphtha	73.17	9.33	99.0
Kerosene	72.31	9.77	99.0
Liquefied Petroleum Gas (LPG)	62.30	5.95	99.0
Reformulated Motor Gasoline	NA	NA	NA
Motor Gasoline	70.91	8.87	99.0
Residual Fuel	78.80	11.79	99.0
Propane	NA	5.70	99.5
Butane	NA	6.52	99.5
Methanol (neat)	NA	4.11	99.0

Note: Emission factors are based on complete combustion and high heating value (HHV).

Sources: Emission factors are derived from: California Energy Commission, *Inventory of California Greenhouse Gas Emissions and Sinks: 1990-1999* (Draft: December 2001), Tables 2-5 & 2-6, page 33; Energy Information Administration, *Emissions of Greenhouse Gases in the United States 2000*, (2001), Table B1, page 140, see **http://www.eia.doe.gov/oiaf/1605/ggrpt**; propane and butane emission factors and fractions oxidized from U.S. Environmental Protection Agency, *Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition*, see **http://www.epa.gov/ttn/chief/ap42/index.html**. Methanol emission factor is calculated from the properties of the pure compounds; the fraction oxidized is assumed to be the same as for other liquid fuel.

Unadjusted Emission Information for Stationary Combustion

Table C-3 provides unadjusted emission information for stationary combustion. In contrast to Table C-3, Table 7-2 contains emission factors that have been adjusted to include the fraction of carbon oxidized.

See Chapter 7
Table 7-2
Adjusted Emission Factors for Stationary Combustion

Table C-3 Carbon Dioxide Emission Factors and Oxidation Rates for Stationary Combustion

Fuel	Carbon Dioxide Emission Factor			Fraction of Carbon Oxidized
	kg CO_2/MMBtu (California)	kg CO_2/MMBtu (U.S.)	kg CO_2/gallon	
Coal				
Residential Coal	92.77	95.33	NA	99.0 %
Commercial Coal	92.77	95.33	NA	99.0 %
Industrial Coking Coal		93.72	NA	99.0 %
Industrial Other Coal	93.00	93.98	NA	99.0 %
Utility Coal		94.45	NA	99.0 %
Natural Gas		53.05	NA	99.5 %
Petroleum				
Distillate Fuel (Diesel)		73.15	10.15	99.0 %
Kerosene		72.31	9.77	99.0 %
Liquefied Petroleum Gas (LPG)		62.30	5.95	99.0 %
Motor Gasoline		70.91	8.87	99.0 %
Residual Fuel		78.80	11.79	99.0 %
Propane		NA	5.70	99.5 %
Butane		NA	6.52	99.5 %
Methanol (neat)		NA	4.11	99.0 %
Crude Oil		74.18	10.24	99.0 %
Still Gas		64.20	NA	99.5 %

Note: Emission factors are based on complete combustion and high heating value (HHV). Emission factors for coking and utility coals are not given for California because they are not consumed in the state.

Sources: Emission factors are derived from: California Energy Commission, *Inventory of California Greenhouse Gas Emissions and Sinks: 1990-1999* DRAFT (December 2001), Tables 2-5 & 2-6, pages 33-34; and Energy Information Administration, *Emissions of Greenhouse Gases in the United States 2000* (2001), Table B1, page 140, see **http://www.eia.doe.gov/oiaf/1605/ggrpt**. Propane and butane emission factors and fractions oxidized from U.S. Environmental Protection Agency, *Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition*, see **http://www.epa.gov/ttn/chief/ap42/index.html**. Methanol emission factor is calculated from the properties of the pure compounds; the fraction oxidized is assumed to be the same as for other liquid fuels.

Appendix D Industry-Specific Metrics for Determining Emission Intensity

The following table provides industry-specific metrics that ***may be used*** to measure energy and GHG emissions. The Registry will work with the CEC and interested stakeholders to develop industry specific protocols and metrics that will provide guidance for reporting and certifying annual emission baselines, and measures of efficiency for entities in various industries/sectors. The table below was compiled by researchers at the Lawrence Berkeley National Laboratory (LBNL).

Table D-1 Industry-Specific Metrics, Ranked by California Industrial Combined Electricity and Natural Gas Consumption (Listed by Largest to Smallest Subsector)

SIC Code	Description	Energy Metric	Emissions Metric	Source
13	**Oil and Gas Extraction**			
		Production Energy Intensity	Production Carbon Intensity (PCI) = CO2eq./cubic meter oil eq.	CAPP, 2000
131	Crude petroleum and natural gas			
132	Natural gas liquids			
138	Oil and gas field services			
29	**Petroleum and Coal Products**			
		Energy Intensity Index (EII)	GHG/$ gross output	Solomon Associates, 2001
		Energy/$ gross output	GHG/GDP	Nyboer and Laurin, 2001a
		Energy/GDP		Nyboer and Laurin, 2001b
291	Petroleum refining	Energy efficiency index	GHG/cubic meter fossil fuels	Ministry of Economic Affairs, 1998
		Energy/cubic meter fossil fuels	GHG/$ gross output	Nyboer and Laurin, 2001a
		Energy/$ gross output	GHG/GDP	Nyboer and Laurin, 2001b
		Energy/GDP		
295	Asphalt paving and roofing materials			
299	Misc. petroleum and coal products			
20	**Food and Kindred Products**			
201	Meat products	Energy/tonne		Institute for Energy Technology, 1998
		Energy efficiency index		Ministry of Economic Affairs, 1998

20	**Food and Kindred Products**			
202	Dairy products	Energy efficiency index	GHG/kiloliter milk and cream	Ministry of Economic Affairs, 1998
		Energy/liter weighted production	GHG/$ gross output	Institute for Energy Technology, 1998
		Energy/tonne milk and cream	GHG/GDP	Nyboer and Laurin, 2001a
		Energy/$ gross output		Nyboer and Laurin, 2001b
		Energy/GDP		
203	Preserved fruits and vegetables	Energy efficiency index	GHG/$ gross output	Ministry of Economic Affairs, 1998
		Energy/$ gross output	GHG/GDP	Nyboer and Laurin, 2001a
		Energy/GDP		Nyboer and Laurin, 2001b
204	Grain mill products			
205	Bakery products	Energy/kg bread	GHG/$ gross output	Institute for Energy Technology, 1998
		Energy/$ gross output	GHG/GDP	Nyboer and Laurin, 2001a
		Energy/GDP		Nyboer and Laurin, 2001b
206	Sugar and confectionery products	Energy efficiency index		Ministry of Economic Affairs, 1998
207	Fats and oils	Energy efficiency index		Ministry of Economic Affairs, 1998
208	Beverages	Energy/$ gross output	GHG/$ gross output	Nyboer and Laurin, 2001a
		Energy/GDP	GHG/GDP	Nyboer and Laurin, 2001b
	Soft Drinks	Energy efficiency index	GHG/$ gross output	Ministry of Economic Affairs, 1998
		Energy/$ gross output	GHG/GDP	Nyboer and Laurin, 2001a
		Energy/GDP		Nyboer and Laurin, 2001b
	Brewery Products	Energy/hectoliter of beer equiv	GHG/hectoliter of beer	Institute for Energy Technology, 1998
		Energy/hectoliter of beer	GHG/$ gross output	Nyboer and Laurin, 2001a
		Energy/$ gross output	GHG/GDP	Nyboer and Laurin, 2001b
		Energy/GDP		
209	Misc. food and kindred products			
32	**Stone, Clay, and Glass Products**			
	Glass and glass products	Energy efficiency index	GHG/$ gross output	Ministry of Economic Affairs, 1998
		Energy/$ gross output	GHG/GDP	Nyboer and Laurin, 2001a
		Energy/GDP		Nyboer and Laurin, 2001b
321	Flat glass			
322	Glass & glassware, pressed or blown			
323	Products of purchased glass			
324	Cement, hydraulic	Energy efficiency index	GHG/tonne clinker	Ministry of Economic Affairs, 1998
		Energy/tonne clinker	GHG/$ gross output	Nyboer and Laurin, 2001a

32	**Stone, Clay, and Glass Products**			
		Energy/$ gross output	GHG/GDP	Nyboer and Laurin, 2001b
		Energy/GDP		
325	Structural clay products (bricks, tile)	Energy efficiency index		Ministry of Economic Affairs, 1998
326	Pottery	Energy efficiency index		Ministry of Economic Affairs, 1998
327	Concrete, gypsum & plaster products			
328	Cut stone and stone products			
329	Misc. nonmetallic mineral products			
28	**Chemicals and Allied Products**			
		Energy efficiency index	GHG/tonne chemical products	Ministry of Economic Affairs, 1998
		Energy/$ gross output	GHG/$ gross output	Nyboer and Laurin, 2001a
		Energy/GDP	GHG/GDP	Nyboer and Laurin, 2001b
281	Industrial inorganic chemicals	Energy/tonne inorganic chemicals	GHG/tonne inorganic chemicals	Nyboer and Laurin, 2001a
		Energy/$ gross output	GHG/$ gross output	Nyboer and Laurin, 2001b
		Energy/GDP	GHG/GDP	
286	Industrial organic chemicals	Energy/$ gross output	GHG/$ gross output	Nyboer and Laurin, 2001a
		Energy/GDP	GHG/GDP	Nyboer and Laurin, 2001b
287	Agricultural chemicals	Energy/tonne chemical fertilizers	GHG/tonne chemical fertilizers	Nyboer and Laurin, 2001a
		Energy/$ gross output	GHG/$ gross output	Nyboer and Laurin, 2001b
		Energy/GDP	GHG/GDP	
	Chemical fertilizers	Energy/tonne fertilizers	GHG/tonne fertilizers	Nyboer and Laurin, 2001a
		Energy/$ gross output	GHG/$ gross output	Nyboer and Laurin, 2001b
		Energy/GDP	GHG/GDP	
1	**Agricultural Production-Crops**			
36	**Electronic and Other Electric Equipment**			
		Energy/$ gross output	GHG/$ gross output	Nyboer and Laurin, 2001a
		Energy/GDP	GHG/GDP	Nyboer and Laurin, 2001b
33	**Primary Metal Industries**			
		Energy/$ gross output	GHG/$ gross output	Nyboer and Laurin, 2001a
		Energy/GDP	GHG/GDP	Nyboer and Laurin, 2001b
331	Blast furnace and basic steel	Energy efficiency index	GHG/tonne steel	Ministry of Economic Affairs, 1998
		Energy/tonne steel	GHG/$ gross output	Nyboer and Laurin, 2001a
		Energy/$ gross output	GHG/GDP	Nyboer and Laurin, 2001b
		Energy/GDP		

33	**Primary Metal Industries**			
332	Iron and steel foundries	Energy efficiency index		Ministry of Economic Affairs, 1998
		Energy/$ gross output	GHG/$ gross output	Nyboer and Laurin, 2001a
		Energy/GDP	GHG/GDP	Nyboer and Laurin, 2001b
	Non-ferrous Metal Smelters & Refineries	Energy efficiency index		Ministry of Economic Affairs, 1998
		Energy/$ gross output	GHG/$ gross output	Nyboer and Laurin, 2001a
		Energy/GDP	GHG/GDP	Nyboer and Laurin, 2001b
	Primary Production of Aluminum	Energy/tonne aluminum	GHG/tonne aluminum	Institute for Energy Technology, 1998
				Nyboer and Laurin, 2001a
				Nyboer and Laurin, 2001b
3335	Aluminum rolling and drawing	Energy/$ gross output	GHG/$ gross output	Nyboer and Laurin, 2001a
		Energy/GDP	GHG/GDP	Nyboer and Laurin, 2001b
	Copper/Alloy Roll, Cast & Extrude	Energy/$ gross output	GHG/$ gross output	Nyboer and Laurin, 2001a
		Energy/GDP	GHG/GDP	Nyboer and Laurin, 2001b
26	**Paper and Allied Products**			
		Energy efficiency index	GHG/$ gross output	Ministry of Economic Affairs, 1998
		Energy/$ gross output	GHG/GDP	Nyboer and Laurin, 2001a
		Energy/GDP		Nyboer and Laurin, 2001b
261	Pulp mills	Energy/tonne pulpwood	GHG/tonne market pulp	Institute for Energy Technology, 1998
		Energy/tonne thermomechanical pulp	GHG/$ gross output	Nyboer and Laurin, 2001a
		Energy/tonne chemical pulp	GHG/GDP	Nyboer and Laurin, 2001b
		Energy/tonne market pulp		
		Energy/$ gross output		
		Energy/GDP		
262	Paper mills	Energy/tonne paper	GHG/tonne pulp and paper	Institute for Energy Technology, 1998
		Energy/tonne pulp and paper	GHG/$ gross output	Nyboer and Laurin, 2001a
		Energy/$ gross output	GHG/GDP	Nyboer and Laurin, 2001b
		Energy/GDP		
263	Paperboard mills	Energy/tonne paperboard	GHG/tonne paperboard	Nyboer and Laurin, 2001a
				Nyboer and Laurin, 2001b
34	**Fabricated Metal Products**			
		Energy/$ gross output	GHG/$ gross output	Nyboer and Laurin, 2001a
		Energy/GDP	GHG/GDP	Nyboer and Laurin, 2001b

37	**Transportation Equipment**			
		Energy/$ gross output	GHG/$ gross output	Nyboer and Laurin, 2001a
		Energy/GDP	GHG/GDP	Nyboer and Laurin, 2001b
371	Motor vehicles and equipment	Energy/1000 cars and trucks	GHG/1000 cars and trucks	Nyboer and Laurin, 2001a
		Energy/$ gross output	GHG/$ gross output	Nyboer and Laurin, 2001b
		Energy/GDP	GHG/GDP	
3714	Motor vehicle parts and accessories	Energy/$ gross output	GHG/$ gross output	Nyboer and Laurin, 2001a
		Energy/GDP	GHG/GDP	Nyboer and Laurin, 2001b
35	**Industrial Machinery and Equipment**			
		Energy/$ gross output	GHG/$ gross output	Nyboer and Laurin, 2001a
		Energy/GDP	GHG/GDP	Nyboer and Laurin, 2001b
30	**Rubber and Miscellaneous Plastics Products**			
		Energy efficiency index	GHG/tonne rubber products	Ministry of Economic Affairs, 1998
		Energy/tonne of rubber products	GHG/$ gross output	Nyboer and Laurin, 2001a
		Energy/$ gross output	GHG/GDP	Nyboer and Laurin, 2001b
		Energy/GDP		
22	**Textile Mill Products**			
		Energy/$ gross output	GHG/$ gross output	Nyboer and Laurin, 2001a
		Energy/GDP	GHG/GDP	Nyboer and Laurin, 2001b
227	Carpets and rugs	Energy efficiency index		Ministry of Economic Affairs, 1998
24	Lumber and wood products			
14	Nonmetallic mineral, except fuels			
38	Instruments and related products			
27	Printing and publishing			
15	General building contractors			
2	Agricultural production - livestock			
39	Miscellaneous manufacturing industries			
23	Apparel and other textile products			
25	Furniture and fixtures			
10	Metal mining			
31	Leather and leather products			

Source: Lawrence Berkeley National Laboratory, *Technical Analysis in Support of California Climate Action Registry* (June 28, 2002).

Appendix E Reference Tables

Table 5-1 Adjusted Average Electricity Emission Factors by State and Region[11]

Region/ State	Carbon Dioxide Emission Factor			Methane lbs/MWh	Nitrous Oxide lbs/MWh
	lbs/kWh	short tons/MWh	metric tons/MWh		
Pacific Contiguous	**0.4891**	**0.2435**	**0.2207**	**0.00576**	**0.00402**
California	0.6630	0.3293	0.2989	0.00728	0.00402
Oregon	0.3043	0.1533	0.1380	0.00359	0.00370
Washington	0.2717	0.1337	0.1207	0.00402	0.00435
Pacific Non-contiguous	**1.6957**	**0.8478**	**0.7685**	**0.01750**	**0.01620**
Alaska	1.5000	0.7500	0.6804	0.00739	0.00967
Hawaii	1.8043	0.9033	0.8196	0.02326	0.01989
Mountain	**1.6957**	**0.8489**	**0.7707**	**0.01174**	**0.02565**
Arizona	1.1413	0.5707	0.5174	0.00739	0.01674
Colorado	2.0978	1.0467	0.9489	0.01380	0.03141
Idaho	0.0326	0.0152	0.0141	0.00870	0.00359
Montana	1.5543	0.7793	0.7065	0.01174	0.02467
Nevada	1.6522	0.8250	0.7478	0.00978	0.02120
New Mexico	2.1957	1.0967	0.9946	0.01424	0.03217
Utah	2.0978	1.0511	0.9543	0.01457	0.03348
Wyoming	2.3370	1.1663	1.0576	0.01598	0.03674
West-North Central	**1.8804**	**0.9391**	**0.8522**	**0.01380**	**0.02924**
Iowa	2.0435	1.0228	0.9283	0.01500	0.03239
Kansas	1.8261	0.9152	0.8304	0.01217	0.02761
Minnesota	1.6522	0.8283	0.7511	0.01707	0.02685
Missouri	2.0000	1.0000	0.9076	0.01370	0.03130
Nebraska	1.5217	0.7609	0.6902	0.01033	0.02380
North Dakota	2.4348	1.2185	1.1054	0.01598	0.03685
South Dakota	0.8696	0.4337	0.3935	0.00576	0.01315
West-South Central	**1.5543**	**0.7761**	**0.7043**	**0.00946**	**0.01663**
Arkansas	1.4022	0.6989	0.6348	0.01359	0.02207
Louisiana	1.2826	0.6402	0.5804	0.01022	0.01217
Oklahoma	1.8696	0.9359	0.8489	0.01196	0.02424
Texas	1.5870	0.7957	0.7217	0.00837	0.01587
East-North Central	**1.7717**	**0.8859**	**0.8043**	**0.01337**	**0.02793**
Illinois	1.2609	0.6326	0.5739	0.00891	0.01957
Indiana	2.2609	1.1283	1.0239	0.01554	0.03511
Michigan	1.7174	0.8587	0.7793	0.01587	0.02717
Ohio	1.9565	0.9783	0.8880	0.01413	0.03130
Wisconsin	1.7826	0.8924	0.8098	0.01500	0.02826
East-South Central	**1.6196**	**0.8109**	**0.7359**	**0.01391**	**0.02609**
Alabama	1.4239	0.7130	0.6467	0.01489	0.02424
Kentucky	2.1848	1.0913	0.9902	0.01522	0.03489
Mississippi	1.4022	0.7033	0.6380	0.01435	0.01793
Tennessee	1.4130	0.7043	0.6391	0.01141	0.02304
New England	**1.0652**	**0.5337**	**0.4848**	**0.02250**	**0.01587**
Connecticut	1.0217	0.5120	0.4641	0.01891	0.01304
Maine	0.9239	0.4630	0.4196	0.06141	0.02935
Massachusetts	1.3913	0.6946	0.6293	0.01891	0.01728
New Hampshire	0.7391	0.3707	0.3370	0.01870	0.01533

[11] *Id.*

Region/ State	Carbon Dioxide Emission Factor			Methane lbs/MWh	Nitrous Oxide lbs/MWh
	lbs/kWh	short tons/MWh	metric tons/MWh		
Rhode Island	1.1413	0.5717	0.5185	0.00739	0.00511
Vermont	0.0326	0.0152	0.0141	0.01043	0.00424
Mid Atlantic	**1.1304**	**0.5652**	**0.5120**	**0.01011**	**0.01576**
New Jersey	0.7717	0.3837	0.3478	0.00837	0.00859
New York	0.9348	0.4663	0.4228	0.00880	0.00967
Pennsylvania	1.3696	0.6870	0.6239	0.01163	0.02207
South Atlantic	**1.4674**	**0.7326**	**0.6652**	**0.01380**	**0.02250**
Delaware	1.9891	0.9946	0.9022	0.01337	0.02467
Florida	1.5109	0.7576	0.6870	0.01630	0.01957
Georgia	1.4891	0.7424	0.6728	0.01402	0.02457
Maryland*	1.4891	0.7424	0.6739	0.01283	0.02239
North Carolina	1.3478	0.6750	0.6120	0.01141	0.02207
South Carolina	0.9022	0.4533	0.4109	0.00989	0.01576
Virginia	1.2609	0.6326	0.5739	0.01489	0.02087
West Virginia	2.1522	1.0739	0.9750	0.01489	0.03435
U.S. Average	**1.4565**	**0.7261**	**0.6587**	**0.01207**	**0.02087**

* Includes the District of Columbia.

Note: All emission factors in this table have been adjusted to include a T&D loss factor of 8%. The original, non-adjusted state-level electricity generation emission factors prepared by the Energy Information Administration are provided in Appendix C on page C.1. All emission factors for electricity generation were derived based on higher heating values (HHV). These state-level electricity generation emission factors represent average emissions per kWh or MWh generated by utility and non-utility electric generators for the 1998-2000 time period. EIA's Voluntary Reporting of Greenhouse Gases (1605(b)) Program believes these factors provide reasonably accurate default values for power generated in a given state. However, reporters should use these state- and regional-level factors only if utility-specific or power pool-specific emission factors are not available.

Source: Energy Information Administration, *Updated State-level Greenhouse Gas Emission Factors for Electricity Generation 1998-2002* (April 2002), see **http://www.eia.doe.gov/oiaf/1605/techassist.html**.

Converting to CO_2 Equivalent

To incorporate and evaluate non-CO_2 gases in your GHG emissions inventory, the mass estimates of these gases will need to be converted to CO_2 equivalent. To do this, multiply the emissions in units of mass by the GHG's global warming potential (GWP). Table 5-2 below lists the 100-year GWPs to be used to express emissions on a CO_2 equivalent basis. Equation 5b provides the basic calculation required to determine CO_2e from the total mass of a given GHG using the GWPs published in the IPCC Second Assessment Report.

Equation 5b	Converting Mass Estimates to Carbon Dioxide Equivalent			
Metric Tons of CO_2e	=	Metric Tons of GHG	x	GWP (SAR, 1996)

Table 5-2 Comparison of GWPs from the IPCC's Second and Third Assessment Reports

Greenhouse Gas	GWP (SAR, 1996)	GWP (TAR, 2001)
CO_2	1	1
CH_4	21	23
N_2O	310	296
HFC-123	11,700	12,000
HFC-125	2,800	3,400
HFC-134a	1,300	1,300
HFC-143a	3,800	4,300
HFC-152a	140	120
HFC-227ea	2,900	3,500
HFC-236fa	6,300	9,400
HFC-43-10mee	1,300	1,500
CF_4	6,500	5,700
C_2F_6	9,200	11,900
C_3F_8	7,000	8,600
C_4F_{10}	7,000	8,600
C_5F_{12}	7,500	8,900
C_6F_{14}	7,400	9,000
SF_6	23,900	22,000

Source: U.S. Environmental Protection Agency, *U.S. Greenhouse Gas Emissions and Sinks: 1990-2000* (April 2002).

Table 6-1. Adjusted Carbon Dioxide Emission Factors for Transport Fuels		
	Carbon Dioxide Emission Factor	
Fuel	kg CO_2/MMBtu	kg CO_2/gallon
Natural Gas	52.785	NA
Petroleum		
Aviation Gasoline	68.488	8.237
Distillate Fuel (Diesel Fuel)	72.419	10.049
Jet Fuel, Kerosene	70.171	9.474
Jet Fuel, Naphtha	72.438	9.237
Kerosene	71.587	9.672
Liquefied Petroleum Gas (LPG)	61.677	5.891
Reformulated Motor Gasoline	NA	NA
Motor Gasoline	70.201	8.781
Residual Fuel	78.012	11.672
Propane	NA	5.672
Butane	NA	6.487
Methanol (neat)	NA	4.069

Note: Emission factors are based on complete combustion and high heating value (HHV).

Source: California Energy Commission, *Inventory of California Greenhouse Gas Emissions and Sinks: 1990-1999* (Draft: December 2001), Tables 2-5 & 2-6, page 33; Energy Information Administration, *Emissions of Greenhouse Gases in the United States 2000*, (2001), Table B1, page 140, see **http://www.eia.doe.gov/oiaf/1605/ggrpt**; propane and butane emission factors and fractions oxidized from U.S. Environmental Protection Agency, *Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition*, see **http://www.epa.gov/ttn/chief/ap42/index.html**. Methanol emission factor is calculated from the properties of the pure compounds; the fraction oxidized is assumed to be the same as for other liquid fuel.

Table 6-2. Mobile Source Methane and Nitrous Oxide Emission Factors by Vehicle and Fuel Type in g/mile		
Vehicle Types/Model Years	CH_4 (g/mile)	N_2O (g/mile)
Gasoline Passenger Cars		
Model Year 1966-1972	0.22	0.02
Model Year 1973-1974	0.19	0.02
Model Year 1975-1979	0.11	0.05
Model Year 1980-1983	0.07	0.08
Model Year 1984-1991	0.06	0.08
Model Year 1992	0.06	0.07
Model Year 1993	0.05	0.05
Model Year 1994 - present	0.05	0.04
Diesel Passenger Cars		
All Model Years	0.02	0.02
Gasoline Light Duty Truck (<5750 GVWR*)		
Model Year 1966-1972	0.22	0.02
Model Year 1973-1974	0.23	0.02
Model Year 1975-1979	0.14	0.07
Model Year 1980-1983	0.12	0.13
Model Year 1984-1991	0.11	0.14
Model Year 1992	0.09	0.11
Model Year 1993	0.07	0.08
Model Year 1994 - present	0.06	0.06
Diesel Light Duty Trucks		
All Model Years	0.02	0.03
Gasoline Heavy-Duty Vehicle (>5751 GVWR)		
Model Year 1981 and older	0.43	0.04
Model Year 1982-1984	0.42	0.05
Model Year 1985-1986	0.20	0.05
Model Year 1987	0.18	0.09

Model Year 1988-1989	0.17	0.09
Model Year 1990-2003	0.16	0.13
Diesel Heavy Duty Trucks		
Model Year 1966-1982	0.10	0.05
Model Year 1983-1995	0.08	0.05
Model Year 1996-1999	0.06	0.05
Motorcycles		
Model Year 1966-1995	0.42	0.01
Model Year 1996-1999	0.21	0.01

*GVWR = Gross Vehicle Weight Rating

Note: Emission factors are based on complete combustion and high heating value (HHV).

Source: Derived from California Energy Commissions, *Inventory of California Greenhouse Gas Emissions and Sinks: 1990-1999* (Draft: December 2001), Table 2-20, page 46.

Table 7-2. Adjusted Carbon Dioxide Emission Factors for Stationary Combustion

Fuel	Carbon Dioxide Emission Factors		
	kg CO_2/MMBtu (California)	kg CO_2/MMBtu (U.S.)	kg CO_2/gallon
Coal			
Residential Coal	91.84	94.38	NA
Commercial Coal	91.84	94.38	NA
Industrial Coking Coal		92.78	NA
Industrial Other Coal	92.07	93.04	NA
Utility Coal		93.51	NA
Natural Gas		52.78	NA
Petroleum			
Distillate Fuel		72.42	10.05
Kerosene		71.59	9.67
Liquefied Petroleum Gas (LPG)		61.68	5.89
Motor Gasoline (Conventional)		70.20	8.78
Reformulated Gasoline		69.73	8.55
Residual Fuel		78.01	11.67
Propane		NA	5.67
Butane		NA	6.49
Methanol (neat)		NA	4.07
Crude Oil		73.44	10.14
Still Gas		63.88	NA

Note: Emission factors are based on complete combustion and reflect higher heating value (HHV). Emission factors for coking and utility coals are not given for California because they are not consumed in the state.

Sources: All emission factors except propane, butane, and reformulated gasoline are derived from: California Energy Commission, *Inventory of California Greenhouse Gas Emissions and Sinks: 1990-1999* DRAFT (December 2001), Tables 2-5 & 2-6, pages 33-34; and Energy Information Administration, *Emissions of Greenhouse Gases in the United States 2000* (2001), Table B1, page 140, see **http://www.eia.doe.gov/oiaf/1605/ggrpt**. Propane and butane emission factors and fractions oxidized from Propane and Butane emission factors are derived from U.S. Environmental Protection Agency, *Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition*, see **http://www.epa.gov/ttn/chief/ap42/index.html**. Methanol emission factor is calculated from the properties of the pure compounds; the fraction oxidized is assumed to be the same as for other liquid fuels. Reformulated gasoline (summer) was derived from information provided by the U.S. Energy Information Administration (August 19, 2002).

Table 7-3 Methane (CH_4) and Nitrous Oxide (N_2O) Emission Factors for Stationary Combustion by Sector and Fuel Type

Sector	Fuel	kg CH_4/MMBtu	kg N_2O/MMBtu
Electric Utilities	Coal	0.0011	0.0016
	Petroleum	0.0033	0.0007
	Natural Gas	0.0012	0.0001
	Wood	0.0351	0.0047
Industrial	Coal	0.0111	0.0016
	Petroleum	0.0022	0.0007
	Natural Gas	0.0059	0.0001
	Wood	0.0351	0.0047
Commercial/Institutional	Coal	0.0111	0.0016
	Petroleum	0.0111	0.0007
	Natural Gas	0.0059	0.0001
	Wood	0.3514	0.0047
Residential	Coal	0.3329	0.0016
	Petroleum	0.0111	0.0007
	Natural Gas	0.0059	0.0001
	Wood	0.3514	0.0047

Note: All emission factors have been converted to higher heating value (HHV), assuming LHV is 95% of HHV for coal and petroleum and is 90% of HHV for natural gas and wood.

Sources: Emission factors are derived from: U.S. Environmental Protection Agency, *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2000* (2002), Table C-2, page C-2. EPA obtained original emission factors from the Intergovernmental Panel on Climate Change, *Revised IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual* (1996), Tables 1-15 through 1-19, pages 1.53-1.57.

Table 7-4 Methane (CH_4) and Nitrous Oxide (N_2O) Emission Factors for Petroleum Fuels by Sector and Fuel Type (kg/gallon)

Sector	Fuel	kg CH_4/gallon	kg N_2O/gallon
Electric Utilities	Distillate Fuel	0.0004	0.0001
	Liquefied Petroleum Gas (LPG)	0.0003	0.0001
	Residual Fuel	0.0004	0.0001
Industrial	Distillate Fuel	0.0003	0.0001
	Kerosene	0.0003	0.0001
	Liquefied Petroleum Gas (LPG)	0.0002	0.0001
	Residual Fuel	0.0003	0.0001
Commercial/Institutional	Distillate Fuel	0.0014	0.0001
	Kerosene	0.0014	0.0001
	Liquefied Petroleum Gas (LPG)	0.0010	0.0001
	Motor Gasoline	0.0013	0.0001
	Residual Fuel	0.0015	0.0001
Residential	Distillate Fuel	0.0014	0.0001
	Kerosene	0.0014	0.0001
	Liquefied Petroleum Gas (LPG)	0.0010	0.0001
	Motor Gasoline	0.0013	0.0001
	Propane	9.1×10^{-5}	4.1×10^{-4}
	Butane	9.1×10^{-5}	4.1×10^{-4}

Note: Emission factors have been converted to higher heating value (HHV), assuming LHV is 95% of HHV for all petroleum fuels. Propane and butane emission factors have not been converted, as they reflected HHV in the original EPA source.

Sources: "Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2000" Annex C Table C-2: CH_4 and N_2O Emission Factors by Fuel Type and Sector and Annex W Table W-2: Conversion Factors to Energy Units (Heat Equivalents] (EPA, 2002. U.S. Environmental Protection Agency, Washington, D.C. April. EPA-236-R-02-003).

Appendix F References

Alliance for Responsible Atmospheric Policy, *Global comparative analysis of HFC and Alternative Technologies for Refrigeration, Air Conditioning, Foam, Solvent, Aerosol Propellant, and Fire protection Applications, Final Report* (March 2002).

American Petroleum Institute, *Compendium of Greenhouse Gas Emission Estimation Methodologies for the Oil and Gas Industry, Pilot Test Version* (April 2001).

Australian Greenhouse Office, *Progress Report' Reporting Template* (1999).

California Energy Commission, *Inventory of California Greenhouse Gas Emissions and Sinks: 1990-1999:* (2001).

Canada's Climate Change Voluntary Challenge & Registry Inc., *Registration Guide 1999* (1999).

California Energy Commission, *Committee Report: Guidance to the California Climate Action Registry: General Reporting Protocol*, P500-02-005F (June 2002).

California Energy Commission, *Committee Report: Guidance to the California Climate Action Registry: Certification Protocol*, P500-02-030F (June 2002).

Gas Technology Institute, *GRI-GHGCalc™ Computer Program, Version 1.0,* GRI-99/0086 (December 1999).

Intergovernmental Panel on Climate Change, *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* (2000).

Intergovernmental Panel on Climate Change, *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories, Greenhouse Gas Inventories Reference Manual, Reference Manual, Chapter 1* (1996).

Phylipsen, K., et al., *Handbook on International Comparisons of Energy Efficiency in the Manufacturing Industry,* Department of Science, Technology, Society, Utrecht University, Netherlands (1998).

World Resources Institute and World Business Council for Sustainable Development, *The Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard* (2001), www.ghgprotocol.org.

United Kingdom Department for Environment, Food & Rural Affairs (DEFRA), *Draft Framework Document for the UK Emissions Trading Scheme* (2001).

United Kingdom Department for Environment, Food & Rural Affairs (DEFRA), *Guidelines for the Measurement and Reporting of Emissions in the UK Emissions Trading Scheme* (2001).

U.S. Department of Energy, Energy Information Administration, *Annual Energy Review 2000, Appendix A,* DOE/EIA-0384 (2001).

U.S. Department of Energy, Energy Information Administration, *Emissions of Greenhouse Gases in the United States* (2000).

U.S. Department of Energy, Energy Information Administration, *Instructions for Form EIA-1605 Voluntary Reporting of Greenhouse Gases for Data Through 2000* (2001).

U.S. Department of Energy, Energy Information Administration, *Voluntary Reporting of Greenhouse Gases under Section 1605(b) of the Energy Policy Act of 1992, General Guidelines* (1994).

U.S. Department of Energy, Energy Information Administration, *Updated State-level Greenhouse Gas Emission Factors for Electricity Generation* (2001).

U.S. Environmental Protection Agency, *Estimating Greenhouse Gas Emissions, Volume VIII of the Emissions Inventory Improvement Program (EIIP) Technical Report Series* (October 1999).

U.S. Environmental Protection Agency, *ClimateWise* (1999), http://www.epa.gov/climatewise.

U.S. Environmental Protection Agency, *Composition of Refrigerant Blends* (May 1998), http://www.epa.gov/ozone/title6/snap/lists/refblend.html.

U.S. Environmental Protection Agency, *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2000*, EPA-236-R-02-003 (April 2002).

U.S. Environmental Protection Agency, *Methods for Estimating Methane Emissions from Natural Gas and Oil Systems. Emissions Inventory Improvement Program, Volume VIII, Chapter 3* (1999).

U.S. Environmental Protection Agency, *U.S. Methane Emissions 1990-2020: Inventories, Projections, and Opportunities for Reductions*, EPA-430-R-99-013 (September 1999).

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