



Alliance of the Ports of Canada, the Caribbean,
Latin America and the United States

Understanding and Estimating Greenhouse Gas Emissions

American Association of Port Authorities
Climate Change Workshop
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Overview

- What Are Greenhouse Gases?
- Where Do They Come From?
- What Sources Do I Have at My Seaport?
- What Should I Include in my Inventory?
- How Do I Estimate GHG Emissions?

What Are the Greenhouse Gases and Where do they Come From?

- Carbon dioxide (CO_2)
- Methane (CH_4)
- Nitrous oxide (N_2O)
- Fluorinated gases
 - Hydrofluorocarbons
 - Perfluorocarbons
 - Sulfur hexafluoride (SF_6)

What Are the Greenhouse Gases and Where do they Come From?

- Carbon dioxide (CO₂)
 - CO₂ equivalence: 1
 - Combustion
 - Fossil Fuel
 - Biomass
 - Industrial Processes
(e.g., cement manuf.)



What Are the Greenhouse Gases and Where do they Come From?

➤ Methane (CH₄)

- CO₂ equivalence: 21
- Oil & Gas Production and Transport
- Decomposition Processes
- Livestock (enteric decomposition)
- Incomplete Combustion



What Are the Greenhouse Gases and Where do they Come From?

➤ Nitrous Oxide (N_2O)

- CO_2 equivalence: 310
- Agricultural Soil and Manure Management
(e.g., from fertilizer use)
- Industrial Processes (e.g., nitric acid prod.)
- Fuel Combustion



What Are the Greenhouse Gases and Where do They Come From?

➤ Fluorinated Gases

- CO₂ equivalence: 140-23,900
(known as high-global warming potential gases)
- Replacement of Ozone-Depleting Substances
(CFCs, HCFCs, halons)
- Industrial Processes (e.g., aluminum production,
semi-conductor manufacturing)
- Electric Power Industry (SF₆)

What Are the Greenhouse Gases and Where do they Come From?

- Most Port-Related Sources of GHGs involve Fuel Combustion
- CO₂, CH₄, N₂O
- Of these, CO₂ accounts for approx. 99% of global warming potential in CO₂ equivalents

What are the Typical Sources of Greenhouse Gases at a Seaport?

➤ Direct Combustion of Fuels

- Marine Vessels
- Terminal Equipment
- Trucks and Other On-Road Vehicles
- Locomotives
- Facilities (boilers, water heaters, space heating, etc.)



What Scope of Activities Should I Include? (The Scope Question)

- “Port Authority” vs “Port”
- Port Authority-Owned Equipment, Vehicles, Buildings
- Tenants’ Activities, Equipment, etc.
- Employees’ Activities – e.g., commuting
- Vendors, Visitors, etc.
- Risk of Double-Counting

What Scope of Activities Should I Include? (The Boundary Question)

- Marine Vessels – how far out to sea?
 - Which facilities/berths?
- Trucks, Locomotives, and Other On-Road Vehicles – how far inland?
- Terminal Equipment – self limiting
(generally operates in one location)
- Consistency is Key

How Do I Estimate My Greenhouse Gas Emissions?

➤ Top Down

- Broad Categories
- Overall Fuel Use Measures or Estimates

➤ Bottom Up

- Equipment Specific
- Activity or Fuel Use Records when Possible
- Build off of Existing Criteria Pollutant Inventory

How Do I Estimate My Greenhouse Gas Emissions?

➤ Fuel Combustion

- Organize by Source Category
- As Much Detail as Possible (sources / fuel types)
- Refueling Records
- Fuel Purchase Records
- Fuel Usage Estimates from Activity Information
- Direct Estimates from Activity Information
(e.g., NONROAD, MOBILE models)

How Do I Estimate My Greenhouse Gas Emissions?

➤ Fuel Types

- Diesel
- Biodiesel (know % if blend, e.g., B20)
- Gasoline (account for ethanol fraction)
- Propane
- Ethanol
- Natural Gas
- Residual Fuel

How Do I Estimate My Greenhouse Gas Emissions?

Emission Factors, mass of GHG per gallon fuel

$$\begin{aligned} & \text{“X” gals fuel} \times \text{“Y” grams CO}_2 \text{ per gal} \\ & = \text{“Z” grams of CO}_2 \text{ (convert to tonnes)} \end{aligned}$$

Or, mass balance based on carbon content of the fuel

$$\begin{aligned} & \text{“X” tonnes fuel} \times \text{“Y” \% carbon} \times (44/12) \\ & = \text{“Z” tonnes CO}_2 \end{aligned}$$

How Do I Estimate My Greenhouse Gas Emissions?

➤ Fuel Usage Estimates from Equipment Activity Information

- Horsepower x load factor x hours = hp-hrs
- Specific fuel consumption (SFC)
= gals per hp-hr
- Multiply hp-hrs by SFC = gallons fuel

How Do I Estimate My Greenhouse Gas Emissions?

- Direct CO₂ Estimates from Activity Information
 - EPA models developed to estimate emissions from vehicles and equipment
 - MOBILE series – on-road vehicles
 - NONROAD series – off-road equipment
 - MOVES – consolidated model, not yet released for use

How Do I Estimate My Greenhouse Gas Emissions?

- Inventory Summary Organized by:
 - Facility / Terminal, etc.
 - Direct (generally fuel)
vs Indirect (generally electricity)
 - Source Category
 - Fuel Type



Summary

- Principal sources of GHGs are fuel burning and electricity consumption
- Defining Geographical and Activity Boundaries is Important
- Remember to track bio-fuel components of diesel and gasoline
- There are many ways to track or estimate fuel usage

Summary

- Organization is Key
 - Emission Sources
 - Records (fuel, electricity)
 - Calculations
 - Assumptions
- Make Use of Resources



For More Information

<http://www.epa.gov/climatechange/index.html>

<http://www.epa.gov/climatechange/emissions/usinventoryreport.html>

<http://www.theclimateregistry.org/about.html>

<http://www.theclimateregistry.org/downloads/GRP.pdf>

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