

METHODOLOGIES AND TOOLS FOR GLOBAL CONSISTENCY OF GREENHOUSE GAS EMISSIONS ESTIMATION AND REPORTING FOR THE OIL & GAS INDUSTRY SECTOR

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ABSTRACT

Global Oil & Gas Industry operations encounter unique operational and business environments while developing greenhouse gas (GHG) management strategies. In all cases companies need consistent, reliable, and credible methodologies to derive GHG emission estimates, along with a common framework for defining the boundaries for reporting emissions. To fulfill this need the American Petroleum Institute (API) developed the “*Compendium of Greenhouse Gas Emissions Estimation Methodologies for the Oil & Gas Industry*” (API Compendium). Over the past couple of years, API has engaged in focused activities to promote harmonization of methodologies worldwide to attain comparability of reported GHG emissions. Moreover, API in collaboration with the International Petroleum Industry Environmental Conservation Association (IPIECA) and the International Association of Oil and Gas Producers (OGP), developed a consistent global framework for accounting and reporting of GHG emissions by the industry sector, titled the “*Petroleum Industry GHG Reporting Guidelines*” (Industry Guidelines).

This paper will provide highlights of the Industry Guidelines and the API Compendium and the SANGEATM software system, originally developed by ChevronTexaco to implement the methodologies embedded in the API compendium. This set of tools provides a framework for consistent estimation, tracking, reporting and managing GHG emissions and energy consumption information.

INTRODUCTION

Understanding the magnitude and sources of greenhouse gas emissions is a critical first step to managing emissions. In addition, with increased attention focused on the potential value – and risk – associated with greenhouse gas emissions, consistent, standardized methodologies for estimating greenhouse gas emissions is crucial to making informed decisions and to tracking progress toward reduction targets. To that end, the worldwide Oil & Gas industry has voluntarily undertaken a significant effort to improve consistency in estimating emissions. The American Petroleum Institute (API) published a ‘road-test’ version of the *Compendium of Greenhouse Gas Emissions Estimation Methodologies for the Oil and Gas Industry* (API Compendium) in April 2001 to assist its members and as a reference for other interested parties [1]. This was

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complemented by a collaborative endeavor by the International Petroleum Industry Environmental Conservation Association (IPIECA), API, and the International Association of Oil and Gas Producers (OGP) to develop the *Petroleum Industry Guidelines for Reporting Greenhouse Gas Emissions* (Industry Guidelines) [2]. Finally, an estimating and reporting tool, the SANGEATM Software System, is now available to enable companies to develop an inventory that is consistent with the Guidelines and utilizes methodologies from the Compendium.

Each of these initiatives was conducted in an effort to better harmonize greenhouse gas emissions estimation and enable improved global comparability. Each of these inventory tools: the Compendium, the Guidelines, and the SANGEATM System, are available at <http://api-ec.api.org/policy/index.cfm?bitmask=001001004002000000>. The Guidelines are also available at <http://www.ogp.org.uk> and <http://www.ipieca.org/reporting/ghg.html>. These guidelines aim to be reliable, efficient, cost effective, comparable, and employ industry endorsed methods. Since reliable inventories are fundamental for all GHG management schemes, these tools can assist the industry at large in their management and reporting of GHG emissions, regulatory compliance, and participation in other voluntary or mandatory schemes such as the US DOE 1605(b) Registry, the EU Emissions Trading, and the Canadian Voluntary Climate Challenge, just to name a few.

INDUSTRY GUIDELINES FOR REPORTING GHG EMISSIONS

The design for harmonization of GHG inventorying and reporting practices includes consistency in accounting issues, such as scope, extent, boundaries, and threshold. Since the Oil & Gas industry utilizes some unique operational arrangements, the determination of ownership and inventory boundaries can be complicated, such as when oil and gas production is conducted under “production sharing agreements” (PSAs) that are legally structured as Joint Ventures, but are implemented in practice as income or production taxes. Table 1 provides the main section headers for the guidelines with an appropriate brief description of their contents.

Table 1. Industry Guidelines: Descriptive Contents

Section Title	Description
1. GHG accounting and reporting principles	Defines principles for transparent, comparable, consistent, cost-effective and reliable accounting of corporate, business or facility (entity) emissions
2. Boundaries for GHG emissions reporting	Discusses accounting for differences in emissions ownership, especially in situations unique to the Oil & Gas industry, such as production lease sharing agreements, tolling arrangements, and outsourcing arrangements
3. Designing an inventory to monitor performance	Recommends boundaries for direct and indirect GHG emissions, including purchased power and heat/steam
4. Identifying industry GHG emissions sources	Describes processes to establish and revise baselines, where appropriate and documents relevant sources and industry operations
5. Evaluating industry GHG emissions	Recommends treatment of emissions inventories to reflect retrospective business portfolio changes

6. GHG emissions reporting	Discusses applicable levels of estimation reliability (accuracy and completeness)
7. Inventory assurance processes	Provides guidance on assurance processes for confirming integrity of inventories

In the development of the Industry Guidelines a wide range of existing and evolving GHG accounting and reporting guidance were considered. The final framework adopted is based, to a large extent, on the *GHG Protocol* that was developed previously by the World Resources Institute (WRI) in collaboration with the World Business Council for Sustainable Development (WBCSD) [3]. The Industry Guidelines contain some modifications to the WRI/WBCSD GHG Protocol based on Oil & Gas industry experience and applicable practices. The Industry Guidelines address both the concepts of GHG accounting and reporting. Accounting is the recognition and consolidation of GHG emissions from operations in which the reporting company holds an interest, and linking the data to specific operations, sites, geographic locations, business processes and owners; while reporting pertains to the presentation of GHG data in formats tailored to the needs of various reporting uses.

The Industry Guidelines emphasize several accounting and reporting principles, including: Relevance, Completeness, Consistency, Transparency and Accuracy. The key issues that are addressed by the guidelines include reporting on an operational control vs. equity share basis. Guidance is provided on selected operational control definitions that are based on industry practices, and the discussion on equity share provides further clarifications for complex Joint-Ventures and various partnering arrangements, such as PSAs. The Industry Guidelines provide a foundation subject to implementation and adoption by member companies based on their internal policies or the requirements of GHG management schemes in which they are participating.

The Industry Guidelines propose a tiered approach for reporting that depends on data availability and its intended use. Such a tiered approach enables reporters with different quality objectives to consider the cost-effectiveness and materiality of quantifying each source category in the context of the facility total. It also provides linkages to the API Compendium, and appropriate methodologies within, which are suitable for calculating emissions for a selected tier. The Industry Guidelines recommend that, as a minimum, companies include in their report direct GHG emissions that are consistent with the selected approach to defining the organization's boundary. They further recommend, as an option, that companies report indirect emissions from the import (consumption) of electricity, steam or hot water, and should maintain these estimated quantities separate from those attributable to direct emissions. They also recognize that in some instances it might be relevant to report other indirect emissions, and in all cases those should be reported separately. For example, such instances might include reporting of GHG emissions from the consumption of imported hydrogen; third-party transport of crude oil and products up to custody transfer; contracted operations such as drilling, or well maintenance; and Toll manufacturing/processing by third parties.

API METHODOLOGY COMPENDIUM

The API Compendium is neither a standard nor a recommended practice for the development of GHG inventories. Rather, it represents a compilation of recognized methodologies for estimating GHG emissions specific to Oil & Gas industry operations. It presents and illustrates

the use of preferred and alternative calculation approaches for CO₂, CH₄, and N₂O emissions for all common sources, including combustion, vented, fugitive, and indirect sources. It provides decision trees to guide the user in selecting estimation techniques based on considerations of materiality, data availability, and accuracy.

The API Compendium was developed to accomplish the following:

- Assemble an expense of relevant emission factors for estimating greenhouse gas emissions from oil and gas industry activities, based on currently available public documents;
- Outline detailed procedures for conversions between different measurement unit systems, with particular emphasis on implementation of oil and gas industry standards;
- Provide descriptions of the multitude of oil and gas industry operations—from exploration and production through refining to the marketing of products, as well as the transportation of crude oil, natural gas and petroleum products—and the associated emissions sources that should be considered;
- Develop emission inventory examples—based on selected facilities from the various industry segments—to demonstrate the broad applicability of the methodologies.

A revised and updated version of the API Compendium was released recently, following several years of ‘road-testing’ of the 2001 pilot version [4], as highlighted in Table 2 below.

Table 2. API Compendium – Descriptive Contents

Section Title	Description
1.0 INTRODUCTION	Provides background and an overview of the document, including highlights of its organization
2.0 INDUSTRY DESCRIPTION	Provides a description of the various industry segments, such as exploration, production and gas processing; coal bed methane production; minerals and mining operations; transportation and distribution; refining; petrochemical manufacturing; marketing; and electricity and heat generation.
3.0 TECHNICAL CONSIDERATIONS	Highlights some key considerations such as the type of emission sources (combustion, vented, fugitives); and GHG species or constituents that need to be addressed. Also provided are relevant global warming potential; data requirements; assumptions, units and units conversion; fuel properties; and emission factors quality ratings and confidence intervals.
4.0 COMBUSTION EMISSIONS ESTIMATION METHODS	Includes full details of estimating GHG emissions from combustion devices, including preferred and alternative methods, with appropriate decision trees and calculation examples. Methods are provided for both internal and external combustion units, flares, and transportation sources, along with emissions associated with the purchase of electricity, heat or steam.
5.0 VENTED EMISSION ESTIMATION METHODS	Includes full details of estimating GHG emissions from various vented sources, including: gas treatment processes; refinery processes; cold process vents; storage tank emissions; loading, ballasting, and transit losses; and other venting sources (i.e. pneumatic devices, exploratory drilling and well testing, coal mining and chemical production). It also provides methods for estimating GHG emissions from non-routine activities.
6.0 FUGITIVE EMISSION ESTIMATION METHODS	Includes full details of estimating GHG emissions from fugitive emissions sources, including: process equipment leaks, anaerobic water treatment and biotreaters.
7.0	Includes detailed examples of how the methodology could be applied to a

EMISSION INVENTORY EXAMPLES	variety of industry facilities, including: exploration and production; natural gas processing plant; transportation; refining; and marketing terminals
Appendix A	Protocol Comparison Summary
Appendix B	Additional Calculation Approaches
Appendix C	Nitrous Oxide Emissions Study

The recent release represents the culmination of extensive collaboration with other industry-related protocol development organizations and represents industry best practices for estimating greenhouse gas emissions from Oil & Gas industry operations.

Figures 1 and 2, below, are extracted from Section 7.0 of the API Compendium, which provides emission inventory examples. These two examples are provided here to illustrate the type of final GHG emission results that are obtained from the application of the recommended methodology in the API compendium. Figure 1 shows the results for a hypothetical Natural Gas processing plant with a throughput of 800 million sft³ (22.65 million m³) of raw gas per day. The calculation applies to a facility that its raw gas contains @ 70% CH₄ and 3.5% CO₂, while the finished product contains >90% CH₄ and <2% CO₂. This facility is self-sufficient and does not import any electricity.

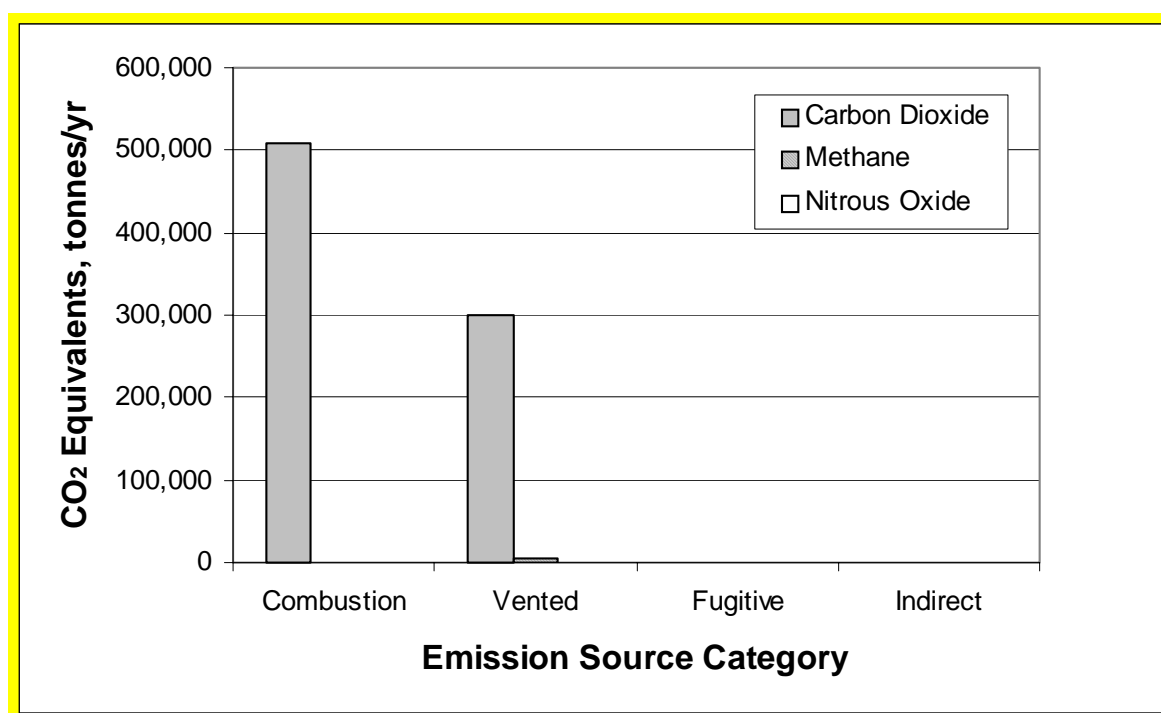


Figure 1. Natural Gas Processing Plant Summary of Emissions

Figure 2 provides a similar summary for a hypothetical refinery. The refinery simulated includes an on-site Hydrogen plant as well as a catalytic cracking unit. Its refining capacity is 250,000 Barrels (39,750 m³) of crude per day, with a Hydrogen plant capacity of 29 million sft³ (0.82 million m³) per day. For the refinery, the combustion sources are fired with either refinery fuel

gas or natural gas. In addition, it is assumed that the facility imported 76,000 megawatt-hours (MW-hr) of electricity for the inventory year.

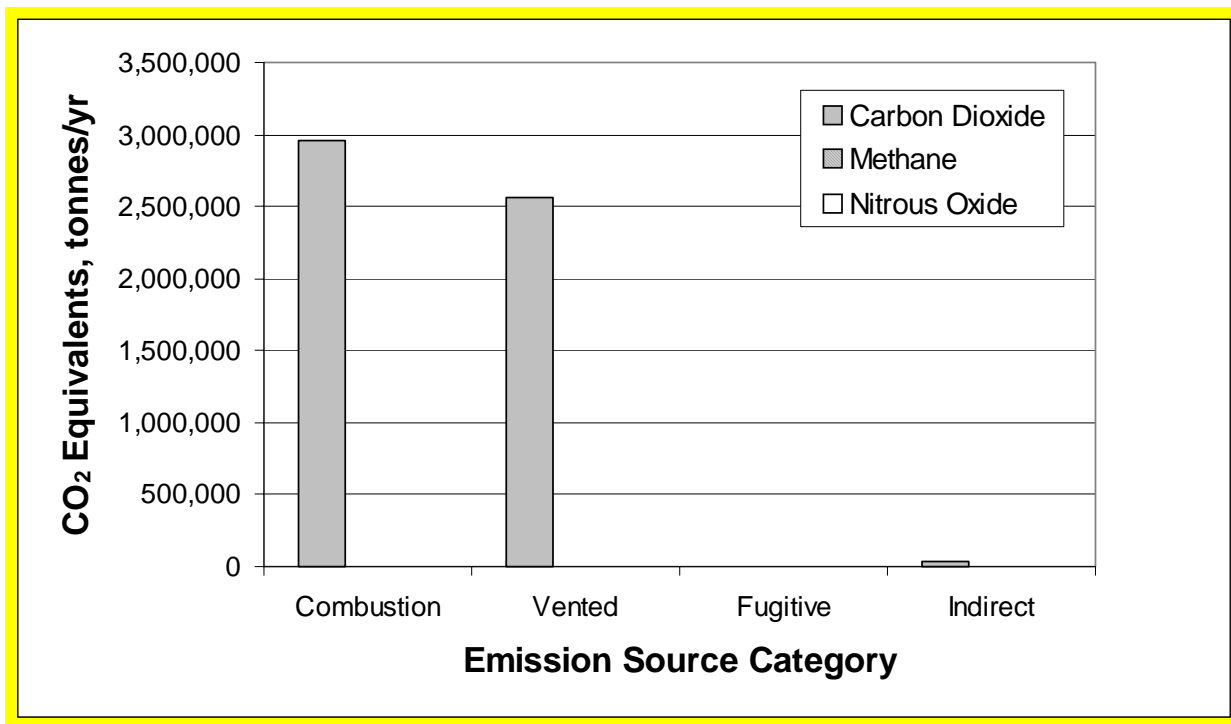


Figure 2. Refinery Summary of Emissions

SANGEA™ SOFTWARE SYSTEM

In order to effectively manage greenhouse gas emission data within the boundaries established by the Industry Guidelines and consistently apply the methodologies from the API Compendium, an electronic data management tool is highly valuable. The SANGEA™ software system is such a tool. The SANGEA™ system is modular so that it can be used to estimate energy utilization and greenhouse gas emissions from all types of Oil & Gas industry sources, including combustion devices, flaring, venting, fugitives, and indirect emissions associated with energy purchases. Users can configure the system for their information needs by entering data about the operational status and equity ownership for each location in the reporting entity, and by selecting the applicable calculation modules. The SANGEA™ system allows users to document the data sources associated with input values, and it features automatic confirmation that the necessary input data and documentation fields are complete. It includes a display of error messages to guide the user to gaps that need to be addressed to complete a given report.

The SANGEA™ System includes the following features:

- Account for emissions on both an Operated and Equity Share basis;
- Account for and report direct and indirect emissions separately;

- Assess energy utilization and greenhouse gas emissions to identify and prioritize major sources;
- Guide energy and greenhouse gas emissions management activities by enabling comparisons of emissions for similar activities;
- Forecast emissions, both for business as usual and for new energy efficiency projects;
- Set goals for improving energy efficiency and decreasing greenhouse gas emissions;
- Track progress toward interim and final goals;
- Document progress against a baseline for potential future crediting;
- Provide a basis for understanding the multiple parameters that affect energy utilization and greenhouse gas emissions from diverse industry operations.

The SANGEA™ software allows users the flexibility to set up the inventory at the level of aggregation that is suitable to their needs. The SANGEA™ system allows the user to choose from a variety of SI and English units of measure for input and output data, and it includes default fuel composition information and default values for emission factors for all modules, based on the API Compendium.

SUMMARY

A credible, systematic approach, as embodied in the Industry Guidelines, the API Compendium and the SANGEA™ software system, provide strategic value to the oil & gas industry as it addresses the climate change issue. By working towards a consistent approach for greenhouse gas emissions estimating, the industry improves its credibility and provides a foundation for future cooperative efforts among member companies, regulators and other industries to address this important issue. By providing a consistent, comprehensive tool for accounting, estimating and reporting emissions, industry groups are helping their members address this important issue in a meaningful way.

The suite of tools, consisting of the API Compendium, the Industry Guidelines, and the SANGEA™ system, will enable petroleum industry companies to,

1. Evaluate the range of relevant options on accounting, estimating and reporting GHG emissions,
2. Select a specific approach that will depend, to a large extent, on the intended use of the information companies are reporting,
3. Determine the specific rules that are applicable for reporting these emissions, based on its participation in specific reporting programs,
4. Consider the broad scope of the industry guidance described above, and implement it, where no local rules are available or as specific circumstances might dictate.

The Oil & Gas industry sector plans to continue and disseminate these guidelines broadly, worldwide, and provide workshops and training in the use of the methodologies. The industry will also continue to collaborate with governmental and intergovernmental organizations on further refinement and updates of this guidance as new technical information becomes available.

REFERENCES

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