Development of a Corporate-wide Process for Estimating Energy Consumption and Greenhouse Gas Emissions from Oil and Gas Industry Operations

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ABSTRACT

ChevronTexaco Corporation believes that global climate change is an important issue and is taking action to address it in a serious way. We recently developed a corporate-wide system for estimating greenhouse gas emissions.

ChevronTexaco Corporation's new system, the ChevronTexaco Energy and Greenhouse Gas Inventory System (CEGIS), is an automated, electronic data management information system that is designed to gather monthly energy and greenhouse gas emissions data from ChevronTexaco Corporation's worldwide exploration and production, refining and marketing, petrochemicals, transportation and coal production activities. ChevronTexaco Corporation and its Chevron, Texaco and Caltex facilities enter data to calculate greenhouse gas emissions and energy utilization on a monthly basis. At the end of each quarter, energy and greenhouse gas emission estimates are reported to ChevronTexaco Corporation.

This paper will review system scope and boundaries, give an overview of how the system works and highlight key innovations of the system.

CEGIS helps ChevronTexaco Corporation's business by enabling each facility to efficiently measure and therefore manage energy utilization and greenhouse gas emissions. Minimizing energy utilization saves money and helps us operate more efficiently. Managing our greenhouse gas emissions helps us address the important issue of global climate change in a verifiable and proactive manner, and demonstrates our commitment to deal with this issue.

INTRODUCTION

ChevronTexaco Corporation is a global company providing energy and chemical products and services vital to the growth of the world's economies. Our core values

include a commitment to protecting the safety and health of people and the environment. This commitment is a critical component of the value we deliver to our stockholders, customers, government partners and employees.

ChevronTexaco Corporation is responding to the concern about climate change with a four-fold plan of action. We are:

- Reducing emissions of greenhouse gases and increasing energy efficiency
- Investing in research, development and improved technology
- Pursuing business opportunities in promising innovative energy technologies
- Supporting flexible and economically sound policies and mechanisms that protect the environment

The ChevronTexaco Energy and Greenhouse Gas Inventory System was designed to enable us to establish a reliable baseline and have a verifiable inventory of greenhouse gas emissions. This will enable us to pursue our goal of reducing emissions per unit output from our operations.

BACKGROUND

The ChevronTexaco Energy and Greenhouse Gas Inventory System (CEGIS) was developed using the ChevronTexaco Project Development and Execution Process (CPDEP). CPDEP is a five-step process:

1. Define the Opportunity
2. Assess Alternatives
3. Develop Preferred Alternative
4. Execute
5. Operate and Evaluate

The first two steps of the CTPDEP process are critical to making sure that the final product is something that will meet customers needs.

1. DEFINE THE OPPORTUNITY: SYSTEM SCOPE AND BOUNDARIES

In defining the opportunity for the greenhouse gas emission inventory, we sought input from people throughout our organization, as well as advice from external experts. During this step, we agreed that:

- A single system and set of methodologies should be used throughout the corporation
- The system needed to enable us to report both operated and equity share emissions
- The system needed to include audit trail information so that the inventory could be verified
- The system should be flexible enough to enable us to report for various purposes (local inventory reporting, public reporting, API or OGP questionnaires, etc.)

During this phase, a common scope and boundaries were established. (see Table 1). The CEGIS system enables users to estimate emissions of three of the six gases included under the Kyoto protocol: carbon dioxide, methane and nitrous oxide. The other three Kyoto gases were not included in CEGIS because emissions of these gases from petroleum industry operations are negligible.

A key outcome during this phase was noting the similarities between our existing energy utilization system and the proposed greenhouse gas emission inventory. Because the energy utilization data is a subset of the data needed to estimate greenhouse gas emissions, we designed a system that would estimate both energy utilization and greenhouse gas emissions.

2. ASSESS ALTERNATIVES

Once we had agreed on the purpose, scope and boundaries of the inventory system, we had to review the different approaches that could be taken to implement the system. Alternatives ranged from a custom-built application to simple spreadsheets to a client-server, web-enabled system. Because our company has a standard software/hardware package (the Global Information Link, or GIL), we decided to use an Excel-based program, with a Visual Basic Add-in. The Excel-based program allows users around the world to estimate greenhouse gas emissions without having to load a new program onto their computer. The system can be implemented enterprise-wide, with common emission factors, methodologies, audit trail information and reporting schemes for all facilities.

The spreadsheet and add-in can be transmitted using email, so we were able to avoid bandwidth limitations that currently exist in a few locations. The system is designed such that it can be upgraded to a web-enabled version in the future.

3. DEVELOP PREFERRED ALTERNATIVE

Having selected a basic platform for the software, we then made decisions on system details. Key decisions include:

- In order to make the system streamlined, yet useful to a range of operations (production, refining, electricity generation, pipeline, shipping, etc.), we took a modular approach. Users can select the modules needed to estimate emissions from their operation, without getting confused or bogged down with information they don't need.
- Because ChevronTexaco's equity share and operator status can vary for different profit centers within a business unit, the system is designed so that each reporting entity can specify a number of locations. The locations can be grouped to facilitate data input.
- We developed the system to provide users with flexibility in aggregating their emissions sources. Emissions and energy utilization sources can be entered individually (and identified by permit number, equipment number, or other unique

identification). Alternatively, a number of sources can be grouped, if fuel utilization data is not available on an individual equipment basis.

- In order to facilitate reporting in locations that are estimating greenhouse gases for the first time, we provided default values for many configuration variables, and included a list of standard fuels in the CEGIS software. At the same time, CEGIS was designed so that knowledgeable users can input a local, customized fuel, based on either mass or volume composition, and they can enter site-specific values in place of defaults, when information is available. This allows sophisticated users to develop a more accurate inventory.

4. EXECUTE

With the detailed plan completed, execution of this project mainly involved writing the Visual Basic code and then running tests on the draft software to make sure it was working properly. Because there are twelve modules, each with several options for configuration and data input, the quality assurance testing had to be very thorough and systematic.

As part of the testing process, we sent a 'beta' version of the software to our upstream operations in Kazakhstan and Texas, and to a refinery in California. The field tests provided valuable feedback to improve user-friendliness of the system, and gave us assurance that the spreadsheet/add-in package could be emailed and could function on our computers in various locations.

5. OPERATE AND EVALUATE

The CEGIS system was rolled out to the first group of users in July, 2001. The first report, for January through September 2001, was due in October, 2001, and monthly reporting has continued thereafter. The reporting system works as planned, and we now have a complete year of verifiable data for energy utilization and greenhouse gas emissions for the first group of users. We are reviewing the data and plan to release it later this year. We have a long list of "lessons learned" and suggested improvements, and will have to upgrade the software as our corporate-wide computer system is upgraded to Windows XP. We also maintain both contracted and onsite help desks to guide our users in correctly setting up and maintaining their inventory files.

HOW CEGIS WORKS

As shown in Figure 1, CEGIS begins with the user loading the software on a local computer. Software can be emailed to users, or loaded from a CD-ROM. The user then configures CEGIS for their operation. The configuration process has four steps:

1. Setup Reporting Entity. The first step in configuration is to select the name of the reporting entity. We preloaded the CEGIS software with the names of major business units, and gave each reporting entity a unique identification number in order to facilitate data management at the corporate level.
2. Define Locations. A "location" in CEGIS is a unique combination of equity share and operating status. For reporting entities that are 100% owned and operated by ChevronTexaco, there may be only one "location". For others, such as Production, where ChevronTexaco typically has different equity shares in several oil fields, several locations may need to be set up. Each location can be set up with its own data input sheet, or several locations can be grouped together to facilitate data entry.
3. Load Emissions Modules. Loading emissions modules is simply a matter of selecting relevant modules from the drop-down list. The use of modules for emission categories streamlines CEGIS, because users can select and work with only the modules they need.
4. Configure Energy Utilization and Emissions Sources. Each emission source must be configured within the appropriate module. For example, a furnace would be configured in the Combustion module. Configuration information for a furnace would include its location, type of fuel used, permit number or other unique identification and choice of units for fuel input data. Other emissions sources, such as hydrogen plants or glycol dehydrators, would be configured in the appropriate module, and the user would enter the information needed to calculate energy utilization and emissions for those sources.

After the system is configured, users enter monthly data so that emissions and energy utilization can be calculated. The user is also required to enter audit trail information, so that an auditor could determine and verify the sources of information. CEGIS automatically calculates greenhouse gas emissions and energy utilization, using factors and methodologies from the API Compendium of Greenhouse Gas Emissions Estimation Methodologies for the Oil and Gas Industry.

At the end of each quarter, the user initiates a sign-off process. The sign-off process generates a statement in which the user attests that the data is factual and complete to the best of their knowledge. After the user has signed off, copies of the data are automatically sent to both the corporate database and the manager of the reporting entity.

In order to have verifiable data, the manager must sign off electronically to indicate that the inventory data was prepared by a competent individual and does not exclude any material information. The local file can be used by the reporting entity to help prioritize emissions sources for mitigation, set goals and track progress against goals.

The database file is sent to a central email box, where an extraction program opens the files and loads the information into an Oracle database. The database provides a backup for data storage by the reporting entities, and enables users to generate standard and ad hoc reports as needed at the corporate level.

CONCLUSION

ChevronTexaco Corporation has developed and implemented a verifiable system whereby each facility can estimate and manage its energy utilization and greenhouse gas emissions. Because the system is automatically linked to a central database, data can easily be rolled up for reporting and ad hoc and standard queries can be used to analyze and report the data as needed.

Table 1. Energy and Greenhouse Gas Inventory System Scope and Boundaries

System Element		Notes
GHG Inventory Scope		
Greenhouse Gases	Kyoto Greenhouse Gases Relevant to the Petroleum Industry. Include: • Carbon Dioxide • Methane • Nitrous Oxide	
GHG Emission Sources	On Site Fuel consumption, (upstream and downstream), including emissions of CO_2, CH_4, and N_2O: • Boilers • Heaters • Furnaces • Internal combustion engines • Turbines • fuel cells	

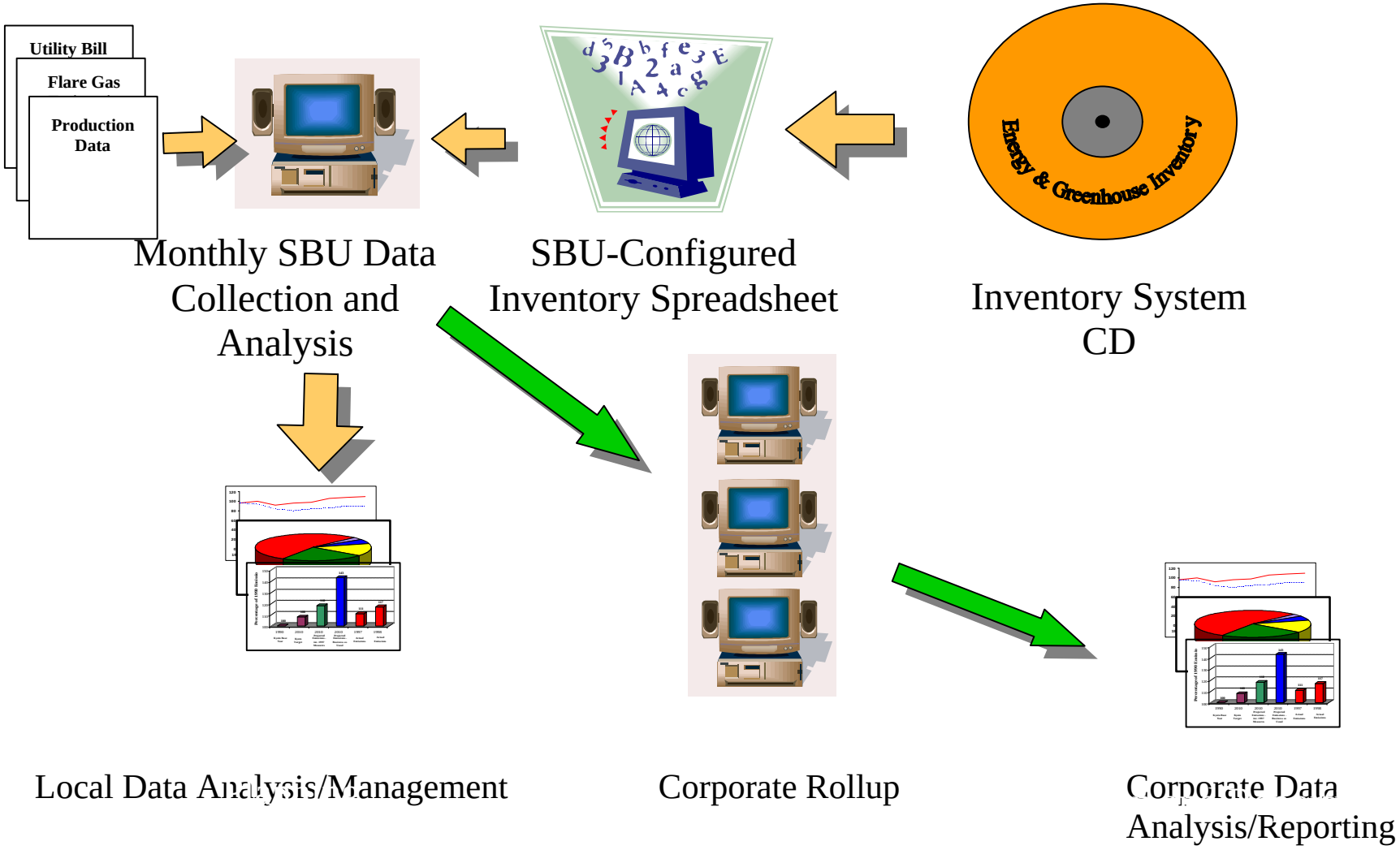
	Process emissions of CH_4 and CO_2, including: • glycol dehydrators • gas treatment processes • sulfur recovery units • hydrogen plants, • catalyst regeneration • fluid cokers and flexi-cokers • asphalt production/blowing	
	Venting of CH_4 and CO_2 from: • inoperative flares • crude oil flashing • pneumatics, starters, and pumps • crude oil storage • loading/unloading operations • shipping operations • purging/venting • exploration and well testing • maintenance and turnaround • non-routine releases	Only need to report the CH_4 and CO_2 components of vented streams. Non-routine releases may be very difficult to evaluate and documentation will provide information about mechanisms for evaluation.
	Flares, including emissions of CO_2, CH_4, and N_2O: • elevated flares, • ground flares	

	Fugitive emissions from CH_4 and CO_2-containing streams, including: • process fugitives (from valves, fittings, flanges, etc.) • pipelines • compressor seals	
	On-site waste treatment emissions of CH_4 and CO_2 from: • incineration/thermal oxidation • wastewater treatment • anaerobic digestion	
	Boundary Issues	
Transportation	Include: • Transportation of raw materials and products by Chevron vessels, vehicles and pipelines (combustion emissions and venting/fugitives) • Shipping in vessels under long-term charter (>6 mos.) • Emissions associated with crude oil loading/unloading of vessels at Chevron terminals, regardless of vessel ownership Not required to include: • All personal transportation • Contracted transport services (except as noted above)	Transportation boundaries are consistent with BP practice

Service Stations	Include: • Chevron owned and operated stations • Chevron owned, dealer operated stations Exclude: • Dealer owned, dealer operated stations	Cannot measure electricity consumption for dealer operated, but can estimate from Chevron operated. This should be reasonably accurate based on average emissions per station.
Partially Owned Operations	Operated JVs: • Track on both operated basis and on Chevron share (apply Chevron percentage to total emissions) • Chevron share defined by contractual arrangement (production share basis, include royalty share) Non-Operated JVs: • Include Chevron share as defined above Equity Only: • Include emissions on equity share basis if Chevron owns > 20% (e.g., Dynegy)	Emissions from non-operated JVs and equity-only businesses to be based on readily obtainable information from operators or simplified emissions estimates. Onus on operator to perform calculations. Caltex and Chevron Phillips to be included For non-equity, we don't book the reserves or report the production. Inventory those that we operate, as a good business practice, but do not include as part of the Corporate Inventory. (Note as asterisks.) Don't double count if companies we own are in a position to do their own inventories (e.g. if Dynegy reports themselves, then we don't report their emissions).

Non-Equity Operations	Chevron receives share of production or fee without holding any equity: • Consider on case-by-case basis	Applies to COPI Venezuela
Indirect Emissions	Include: • Emissions from net purchased electricity and steam Exclude: • Other indirect emissions	
Contracted Activities	Include: • Exploration and production well drilling and well testing activities • Major "captive" contracted operations where output is predominantly to Chevron (e.g., oxygen plant) Exclude: • Construction activities • Tolling operations undertaken by 3rd parties for Chevron • Contracted transportation	
Minor Sources	Include: • Emergency generators and pumps Exclude: • Welding and cutting torches • Portable space heaters • Fire training fires • CO_2 used in fire extinguishing • Emissions and sequestration associated with land use changes	

Figure 1. CEGIS System Architecture



KEY WORDS

Analysis
CEGIS
ChevronTexaco
ChevronTexaco Energy and Greenhouse Gas Inventory System
Corporate-Wide
Data
Energy
Enterprise-Wide
Excel
Greenhouse Gas
Inventory
Reporting