The EPA Corporate GHG Goal Evaluation Model

A Model for Benchmarking GHG Reductions and Evaluating Corporate Climate Performance

Overview

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1.0 Overview

Performance benchmarking is a technique that has been used to rate energy efficiency efforts in products, buildings, and industrial facilities; however, this technique has been used less frequently to evaluate corporate greenhouse gas (GHG) performance. The U.S. Environmental Protection Agency (EPA) developed a sector-based benchmark modeling system as a tool for projecting business-as-usual GHG intensity improvements to help assess corporate GHG reduction targets proposed to EPA as part of its Climate Leaders program. This tool is called the *EPA Corporate GHG Goal Evaluation Model* ("the model") and is available on the EPA's Center for Corporate Climate Leadership website for public use.

Performance benchmarks can be critical in helping organizations set aggressive GHG reduction targets. These types of goals can galvanize emission reduction efforts at a company and lead to the identification of additional reduction opportunities. Additionally, an aggressive GHG goal can help garner senior management attention and increase funding for internal emission reduction projects. Corporate targets can also encourage innovation, improve employee morale, and help in the recruiting and retention of qualified employees.

The purpose of this document is to provide an overview of the methodology and data sources that support EPA's goal model. The model incorporates best available data on energy consumption and production output from the U.S. Energy Information Administration (EIA) and the U.S. Bureau of Labor Statistics (BLS) for commercial and industrial sectors. Information and explanations of how the model utilizes these data sources to calculate benchmark GHG intensity and economic output values is described in detail below.[1] For step-by-step guidance on using the model, please see the *EPA Corporate GHG Goal Evaluation Model - User's Manual*. For additional information on how the latest version of the model was updated and how modelers can make future updates to the model, please see the *EPA Corporate GHG Goal Evaluation Model - Update Process Manual*.

2.0 Performance Benchmark Data Sources

The current version of the model utilizes four data sources to calculate fuel consumption and economic output values for common commercial and industrial sectors. These results are used in combination with emission factors to estimate CO_2 intensity by sector.

2.1 History and Rationale of Data Selection for the Model

The data sources used in the model were selected based on the model's specialized purpose of forecasting business-as-usual GHG emissions intensities for the widest possible set of economic activities in the U.S. economy. While more detailed input-output tables from the U.S. Department of Commerce's Bureau of Economic Analysis (BEA) are available, these are only historical

[1] Portions of this document were taken from the EPA document "Evaluating Corporate Climate Performance: A Model for Benchmarking GHG Reductions," Bella Tonkonogy, Jim Sullivan, and Gregory A. Norris, American Council for an Energy Efficient Economy Summer Study Paper, Summer 2007.

tables—they provide no forecasting ability. In contrast, forecasts of energy use for some of the most energy-intensive sectors within the U.S. economy are available from EIA.

However, for the purposes of the Climate Leaders program, EPA needed *both* a comprehensive treatment of the economy, broken into as many sectors as possible, *and* an ability to forecast business-as-usual emissions for these sectors. Furthermore, these data needed to be transparent and publicly available. Given these parameters, EPA chose to use the input-output table projections and historical tables published by the BLS as these were the only known source of such data in the U.S.

The other data sources EPA drew on to construct the model are those necessary to convert the BLS projections into projections of emissions per unit of sector output, as accurately as possible. For example, the BLS data provide historical and future estimates of purchases of different fuels by each sector of the economy, expressed in dollars. Because GHG emissions depend on the physical quantity of fuel combusted, EPA required fuel prices in order to convert from dollars spent to physical data. And since different sectors pay different prices for fuel, especially among those sectors which use energy more intensively, EPA needed sector-specific prices—historical and projected. In addition, EPA needed information on combustive use as a fraction of total consumption of fuels, since some sectors use fuels as material feedstocks which do not directly emit greenhouse gases.

Here again, EPA's choice of data was clear, but it also required the use of more than one source. First, for detailed data on fuel prices and on combustive use as a fraction of total use in energy-intensive sectors and with differentiation of sectors, there is only one choice: the EIA's Manufacturing Energy Consumption Survey (MECS). The MECS data, however, is only historical data. To fulfill EPA's requirement for future price projections, the EIA's fuel price projections—which pertain to much more aggregated sector groups—were used in combination with historical MECS data and historical EIA fuel prices in order to estimate sector-level fuel price forecasts.

2.2 U.S. Department of Commerce Bureau of Labor Statistics

The Bureau of Labor Statistics input-output data show the flow of commodities from production through intermediate use by industries as well as purchases by final users. The *Inter-Industry Relationships (Input/Output Matrix)* dataset used in the model provides historical and projected input-output for 202 different sectors, based on the 2007 North American Industrial Classification System (NAICS). This data is developed as a set of matrices or tables for each year. The input-output tables produced by the BLS are derived from input-output data initially developed by the U.S. Bureau of Economic Analysis.

For most sectors, the level of detail in the BLS input-output data corresponds to the 4-digit level of the NAICS codes. The "Make" table provides historical estimates and projections for the production of commodities by industries and can be used to estimate total production output from each sector in terms of producers' prices. The "Use" table provides historical estimates and projections for the consumption of commodities by industries. For additional information on these tables, please see Figures 7 and 8 in Section 2.2 of the *EPA Corporate GHG Goal Evaluation Model - Update Process Manual*. The latest version of this BLS dataset, released in 2013, contains

historical data for years 1993 through 2012 and projected data in year 2022. For data years between the historical and projected years, the model estimates the annual production and consumption data via linear interpolation. All production and consumption data is represented in 2005 U.S. dollars ($ millions), which is converted to 2012 dollars using a deflator (see below).

Four of the commodities in the "Use" table are fuel-related: coal, petroleum products, electricity, and natural gas. For each of these energy commodities, the BLS input-output tables provide historical and projected data for total annual consumption by each sector expressed in producers' prices. These data are used together with sector-based historical and price forecast data from three sources published by the EIA: the Annual Energy Outlook (AEO), State Energy Data System (SEDS), and the Manufacturing Energy Consumption Survey (MECS), in order to develop a comprehensive, historical, current, and forecasted price data set that spans the years 1993 to 2022.

Important Note: Recall from the discussion in section 2.1 that price data (historical and projected) is needed in order to convert expenditures into estimates of physical quantities of fuel consumed, and to convert electricity purchases to kWh.

2.3 U.S. Energy Information Administration's Annual Energy Outlook

The EIA's AEO examines energy market trends and focuses on factors that shape the U.S. energy system over the long term. Data utilized in this model was taken from the AEO Reference Case projection. Under the assumption that current laws and regulations remain unchanged throughout the projections, the AEO Reference Case provides the basis for examination and discussion of energy production, consumption, technology, and market trends and the direction they may take in the future. It also serves as a starting point for analysis of potential changes in energy policies.

The model utilizes current year and forecasted price data for a variety of energy commodities (petroleum, natural gas, coal, and electricity) and sectors (industrial, transportation, commercial, residential, and electric). Current year data (in 2012 U.S. dollars/mmbtu) was available for the years 2011 through 2013 with annual year data forecasted from 2014 through 2040. This data was found in Table 3 *Energy Prices by Sector and Source - United States* of the 2014 AEO publication.

2.4 U.S. Energy Information Administration's State Energy Data System

The EIA's SEDS is a collection of state-level energy production, consumption, and price data. The model utilizes national-level price data (in nominal U.S. dollars/million btu) for the same energy commodities and sectors as the AEO data, described above. Historical data for years 1970 through 2012 was found in the file *Prices, 1970–2012*.

The model combines the AEO and SEDS data to create a series of energy prices for each sector from 1970 through 2040. SEDS and MECS both provide historical data while AEO provides

forecast data, helping to provide greater sectoral detail.

2.5 U.S. Energy Information Administration's Manufacturing Energy Consumption Survey

The EIA's MECS dataset covers energy consumption by energy source and industry type. The most current MECS dataset published in 2013 contains 83 industry types,[2] each identified by a NAICS code. Table 7—*Average Prices of Purchased Energy Sources, 2010*—contains the price each industry paid for a variety of energy commodities in 2010 U.S. dollars/mmbtu.

Because the model merges the MECS, AEO, and SEDS datasets, the price data contained in these series should be based in the same units. Therefore, the model converts the AEO and SEDS data to 2012 U.S. dollars by utilizing price deflator data provided by the BEA (Table 1.1.9., *Implicit Price Deflators for Gross Domestic Product, last revised in July 2014*). This data series allows the model to convert energy prices published in multiple years to a single year dollar value.

The table that results from merging the MECS, AEO, and SEDS datasets contains the price each sector paid for each energy commodity between years 1970 and 2040. The sectors found in this table include the five general sectors used by the AEO and SEDs series (Industrial, Transportation, Commercial, Residential, and Electric), and each industrial sector found in the MECS series. A separate table in the model assigns each of the 202 BLS sectors to one of the general sectors or one of the MECS industrial sectors. With these relationships defined, the model is able to associate annual energy prices with each BLS sector. These energy prices—as well as the BLS production and consumption data—are then converted to 2012 U.S. dollars ($ millions).

3.0 Performance Benchmark Methodology

Using the energy price table described above in Section 2.5, in combination with the BLS "Use" table, the model generates estimates of sector-specific energy commodity consumption. By knowing how much each sector spent for each energy commodity in a given year (2012 U.S. dollars, $ millions), as well as the energy prices in a given year (2012 U.S. dollars/mmbtu), the model is able to calculate the quantity of energy and electricity each sector consumed in a given year. The model normalizes this energy consumption data series using BLS industry output (mmbtu per U.S. dollar of output, in producer's prices) for each BLS sector.

By applying fuel-specific CO_2 emissions factors (kg CO_2 per mmbtu) to the resulting data series, the quantity of CO_2 generated by each sector's energy consumption, per dollar of output, is obtained (kg CO_2 per 2012 U.S. dollars).

[2] At the time of publication, EIA had released its preliminary 2010 dataset. EPA will make future updates to the model to reflect the impacts of EIA's final data set.

3.1 Final Result Modeling

Step 1- Define the Company's Information

In order to extract the modeled economic and CO_2 intensity data that is relevant for each company, the model utilizes inputs which the user enters in the "Goal Analysis (For Users)" section of the model. Inputs include:

- Weighted revenue, by NAICS codes (%)
- Goal base year
- Goal target year

Step 2- Calculate Annual Composite Intensity

A company's annual composite intensity (ACI) reflects the fuel-specific annual intensities for each sector relevant to the company. The model estimates fuel-specific GHG emissions intensity for a composite NAICS sector that is a revenue-weighted average of the company's sub-sectors.[3]

The sum of these intensity values across all energy commodities for the base and target year result in a single composite company-wide intensity value. The model also provides the percent change in CO_2 intensity for the company. The user is able to obtain these results by clicking the "Calc" button next to each of these result categories in the "Goal Evaluation Results" section of the model:

- Composite Intensities by Fuel (kg CO_2 per 2012 $ output)
- Composite Intensities, Base and Target Years (kg CO_2 per 2012 $ output)
- Percent Change in Intensity, Base to Target Year (%)

For additional information on how to locate and generate results, please refer to Section 3.1 of the *EPA Corporate GHG Goal Evaluation Model - User's Guide*.

Step 3- Calculate Economic Output

The model pulls the expenditures from the BLS industry output data series for each sector and year selected by the user. Each weighted revenue fraction is applied to the appropriate expenditure to obtain the company's weighted revenue. The model also calculates the difference and percent change in total industry output and weighted output. The user is able to obtain these results by clicking the "Calc" button next to each of these result categories in the "Goal Evaluation Results" section of the model:

- Output in Selected Years (Million CY 2012 $)
- Output in Selected Years with % Change (Million CY 2005 2012 $)
- Weighted output in selected years with change (Million CY 2012 $)

[3] It is important to note that process emissions are not addressed fully by the model. For companies with significant GHG emissions from industrial processes it is very important to take these emissions into consideration when using the model to establish or evaluate a company's GHG target.

3.2 Use of Performance Benchmarks

A performance benchmark can be used as an analytical basis for GHG reduction goal setting. However, goal setting should involve additional evaluations and other sources of information received from a company or from external industry experts, such as unique reduction opportunities specific to that company, qualitative and quantitative evidence of past performance, energy management best practices for the industry, appropriate production metrics, and other company innovations related to GHG management.

The following are links to resources intended to complement this document:

- *The EPA Corporate GHG Goal Evaluation Model: User's Manual*, U.S. EPA, August 2014
- *The EPA Corporate GHG Goal Evaluation Model: Update Process Manual*, U.S. EPA, August 2014
- *Evaluating Corporate Climate Performance: A Model for Benchmarking GHG Reductions*, Bella Tonkonogy, Jim Sullivan, and Gregory A. Norris, American Council for an Energy Efficient Economy Summer Study Paper, Summer 2007.