Evaluating Corporate Climate Performance: A Model for Benchmarking GHG Reductions

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ABSTRACT

Many companies have stepped forward to announce long-term public greenhouse gas (GHG) reduction goals. These companies have generally been lauded by their customers and shareholders for taking proactive steps to address climate change. However, there have been few efforts to evaluate the extent to which these public corporate GHG goals represent actual GHG reductions as opposed to business-as-usual changes expected for their sector.

Performance benchmarking has been used to rate energy efficiency efforts in products, buildings, and industrial facilities. However, benchmarking has been used less frequently to evaluate corporate GHG performance. The U.S. Environmental Protection Agency (EPA) has developed a sector-based benchmark methodology to use as a tool for projecting business-as-usual GHG intensity improvements and assessing corporate GHG reduction goals proposed to the EPA Climate Leaders Partnership. The model incorporates best available data on energy consumption, GHG process emissions, and production output from the U.S. Energy Information Administration and Bureau of Labor Statistics for commercial and industrial sectors, as well as the Integrated Planning Model (IPM) for electric generators developed by ICF International, Inc.

The methodology and results of goal evaluations for several sectors are reviewed, including data sources and data quality, model output, relevance to the proposed corporate goal, and how the analysis was used in evaluating corporate GHG reduction goals. The paper concludes with a discussion of how EPA's analytical approach to evaluating and negotiating GHG reduction goals can motivate companies to take more aggressive actions to reduce their GHG footprint, such as significant energy efficiency improvements.

Background on Climate Leaders

Climate Leaders was launched by EPA in 2002 as an industry-government partnership that works with companies to develop long-term climate change strategies. The program has identified three key components central to a robust GHG management strategy:

1) Inventory corporate-wide emissions of the six major GHGs from direct sources including stationary combustion, mobile combustion, and process and fugitive emissions, and from indirect sources such as electricity and steam purchases;
2) Develop an Inventory Management Plan that describes the process for completing and maintaining a high-quality, corporate-wide inventory; and
3) Set a long-term, forward-looking GHG emissions reduction goal.

Climate Leaders provides direct technical assistance to companies in completing a GHG inventory based on standardized accounting practices[1] and an Inventory Management Plan[2] to ensure credibility and consistency in emissions data, both of which are essential to tracking progress towards meeting a GHG reduction goal. Climate Leaders has also developed a goal-setting review process based on a performance benchmark methodology to ensure that all goals announced under the program are indicative of corporate leadership on climate change, as well as to provide credible third-party feedback to companies prior to their public announcement of a GHG reduction goal.

Climate Leaders Goal-Setting Process

EPA works closely with Partners to set an individualized GHG reduction goal because every company has a unique set of GHG emissions sources and reduction opportunities. This goal must meet the following criteria:

- Corporate-wide (including at least all U.S. operations)
- Based on the most recent base year for which data are available
- Achieved over 5 to 10 years
- Expressed as an absolute GHG reduction or as a decrease in GHG intensity
- Aggressive compared to the projected GHG performance for the Partner's sector

What EPA considers an aggressive goal may vary for different sectors and for different companies depending on a variety of factors:

- *Sector Issues:* Historically, GHG intensity tends to decrease over time in most sectors as equipment is replaced with newer, more efficient technology. This trend can be rapid in sectors where capital stock turns over quickly, and much slower in traditional manufacturing sectors. The rate of intensity improvement can also be affected by the growth rate of the sector.
- *Company Issues:* Partners within the same sector can have different GHG emissions sources and a wide range of reduction opportunities. In addition, some Partners have undertaken GHG reduction activities prior to joining Climate Leaders. These actions are taken into consideration when evaluating a Partner's proposed goal.

To address this variability, Climate Leaders conducts an iterative goal evaluation and approval process based on a performance benchmarking methodology to ensure that all Climate Leaders goals are aggressive. The typical steps in the process include:

1) the Partner completes a corporate-wide inventory to identify risks and reduction opportunities from GHG emissions;[3]

[1] See http://www.epa.gov/climateleaders/resources/guidance.html
[2] See http://www.epa.gov/climateleaders/docs/IMPchecklist.doc
[3] Although many companies have a good idea of their major GHG emissions sources and opportunities prior to completing a corporate inventory, there are enough examples where expected "small" sources, including corporate-owned jets and refrigeration leakage, turn out to be much larger than initially estimated that EPA recommends completing a base year inventory prior to setting a reduction goal.

2) the Partner completes an internal analysis to identify the range of potential internal reduction opportunities;[4]
3) the Partner presents an initial goal proposal to EPA for evaluation;
4) EPA calculates a sector performance benchmark, based on the Partner's sector, to identify an analytical basis for negotiating the reduction goal;
5) EPA and the Partner work together to ensure that the proposed goal significantly exceeds the performance benchmark; and
6) EPA approves the goal for announcement as a Climate Leaders goal.

This paper will provide a description of the performance benchmark methodology that EPA uses in this evaluation process.

Overview of Performance Benchmarking

Performance benchmarking has been used in energy management to evaluate the energy performance of consumer products (Energy Star 2003), buildings (Energy Star 2007), and industry (Boyd & Dutrow 2005; Commissie Benchmarking 1999; Nyboer & Rivers 2002). Additionally, performance benchmarking guidance has recently been developed to determine reductions from a baseline for GHG reduction projects (WRI 2006). Methodologies have been published for specific greenhouse gas reduction projects, such as boiler replacements, landfill gas collection and combustion, and transit bus efficiency (EPA 2006a, b, c).

For Climate Leaders goal-setting, EPA sought to develop a performance benchmark that facilitates the comparison of expected business-as-usual emissions performance of the sector(s) in which a company operates to a company's goal proposal. A "Climate Leader" company would thus distinguish itself by announcing an aggressive GHG reduction goal compared to its sector performance benchmark.

In determining an approach to benchmarking sector GHG performance, EPA, in collaboration with Sylvatica, an environmental consulting firm based in North Berwick, Maine, defined three steps in developing a baseline estimate to be used as the performance benchmark:

1) Identify the data sources needed to estimate the baseline scenario;
2) Identify the methodology to estimate the baseline scenario; and
3) Calculate the baseline estimate.

The benchmark should be developed based on recent data, and the goal's temporal boundary should be agreed upon between EPA and the Climate Leaders Partner, following program goal criteria as outlined earlier in the paper. The benchmark should also allow for differentiation in the mix of activities of each particular company to help reduce uncertainty in the baseline estimate. If, upon calculating the baseline estimate, the Climate Leaders Partner's proposed goal significantly exceeded the benchmark, then the goal may be deemed aggressive by EPA.

[4] This process varies greatly by company depending on type of industry, degree of centralization, engineering expertise, and risk aversion. Traditionally, many companies have set goals based on "bottom up" engineering estimates of planned/proposed reduction projects. Lately there are many more examples of "top down" goals where senior management sets a stretch goal and relies on the ingenuity of employees to propose enough cost-effective projects to achieve it.

Performance Benchmark Data Sources

To develop a baseline estimate, EPA sought publicly available, data-driven, company-relevant projections of future use of fuels and electricity, normalized to a measure of output or business scale. EPA found that, outside of electric utilities, for which a separate model, the Integrated Planning Model,[5] is required and available, there are three different data sources, which have some overlap, and which jointly provide the best available basis for such projections:

1) The Energy Information Administration (EIA)'s Industrial Demand Module (IDM) for projections for a set of 15 energy intensive industries;
2) The Bureau of Labor Statistics (BLS) historical and projected input/output tables for the U.S. economy divided into 200 sectors; and
3) The EIA's projections for energy intensity of commercial buildings.

EIA's Industrial Demand Module

The Industrial Demand Module (IDM) is part of EIA's National Energy Modeling System (NEMS). IDM generates annual mid-term forecasts of industrial sector energy demand. As documented by EIA, IDM receives, as inputs from other portions of the NEMS, fuel prices, employment data, and the value of industrial shipments (DOE/EIA 2006a). Based on the values of these variables, IDM sends back to the NEMS system estimates of consumption by fuel types:

> The NEMS Industrial Model estimates energy consumption by energy source (fuels and feedstocks) for 9 manufacturing and 6 non-manufacturing industries. The manufacturing industries are further subdivided into the energy-intensive manufacturing industries and non-energy-intensive manufacturing industries. The manufacturing industries are modeled through the use of a detailed process flow or end use accounting procedure. The non-manufacturing industries are represented in less detail (DOE/EIA 2006a, 1).

Figure 1 identifies the industry groups modeled in the industrial sector along with their North American Industrial Classification System (NAICS) code coverage. The figure identifies six non-manufacturing industries and nine manufacturing industries. Of the nine manufacturing industries, seven of the most energy-intensive are modeled in greater detail in the Industrial Demand Model.

Bureau of Labor Statistics Input/Output Projections

For businesses whose activities do not fall within the sectors covered by the IDM, another publicly available source is required for projections of sector-based, fuel-specific energy consumption tied to a measure of company scale or output. For this purpose EPA uses the historical and projected input/output tables published annually by the U.S. Department of Commerce's Bureau of Labor Statistics (BLS 2005).

These tables divide the U.S. economy into 200 sectors, based on the 2002 North American Industrial Classification System (NAICS). For most of the sectors, the level of detail in the BLS input/output data corresponds to the 4-digit NAICS codes. The “Make” table

[5] See http://www.epa.gov/airmarkets/progsregs/epa-ipm/index.html, “Integrated Planning Model”.

provides historical estimates and projections for the production of commodities by industries. This table can be used to estimate total output from each sector, in terms of producers' prices. The "Use" table provides historical estimates and projections for the consumption of commodities by industries.

Figure 1. NEMS Industrial Demand Module Categories (DOE/EIA 2006a, 9)

Energy-Intensive Manufacturing	Nonmanufacturing Industries
Food Products (NAICS 311)	Agriculture, Crops (NAICS 111)
Paper and Allied Products (NAICS 322)	Agriculture, Other (NAICS 112-115)
Bulk Chemicals Inorganic (NAICS 32512 to 32518) Organic (NAICS 32511, 32519) Resins (NAICS 3252) Agricultural (NAICS 3253)	Coal Mining (NAICS 2121) Oil and Gas Mining (NAICS 211) Other Mining (NAICS 2122-2123)
Glass and Glass Products (NAICS 3272)	Construction (NAICS 233-235)
Cement (NAICS 32731)	
Iron and Steel (NAICS 3311, 3312)	
Aluminum (NAICS 3313)	
Nonenergy-Intensive Manufacturing	
Metal-Based Durables (NAICS 332-336)	
Balance of Manufacturing (all remaining manufacturing NAICS, excluding Petroleum refining (32410))	

NAICS = North American Industrial Classification System
Source: Office of Management and Budget, *North American Industrial Classification System, United States, 2002* (Springfield, VA, National Technical Information Service, 2002).

Four of the commodities in the "Use" table are fuel-related: coal, petroleum products, electricity, and natural gas. For each of these energy commodities, BLS provides 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 two sources: the State Energy Price and Expenditure Report (SEPER) and the Manufacturing Energy Consumption Survey (MECS) to generate estimates of sector-specific consumption of each of the four energy commodities in physical or energy units. These results are then normalized using the total output data to provide historical data and projections for the consumption of fuels and electricity per dollar of output for each of the 200 sectors.

Commercial Building Energy Use Projections

The commercial sector consumes energy mainly in buildings, except for a relatively small amount for services such as street lights and water supply. The commercial demand model (CDM) is a component of NEMS (DOE/EIA 2006b). Projections of commercial sector energy

demand, by fuel, are based on variables including 1) total floorspace, building type and location; 2) changes in the mix of end–use services provided by energy (such as the penetration of telecommunications equipment, personal computers and other office equipment); 3) changes in the stock of installed equipment caused by the normal turnover of obsolete equipment to newer equipment which tends to be more energy-efficient; 4) the integrated effects of equipment and building shell (insulation level) in new construction, and the projected availability of equipment with even greater energy–efficiency; and 5) the short–run effects of energy prices on energy demands, the longer–run effects of energy prices on the efficiency of purchased equipment, and legislatively imposed minimum efficiency standards (DOE/EIA 2006b).

Projections of annual energy demand by fuel are available from the CDM for each of the following building types:

- Assembly
- Education
- Food Sales
- Food Service
- Health Care
- Lodging
- Large Office (greater than 50,000 ft^2)
- Small Office (less than 50,000 ft^2)
- Mercantile and Service
- Warehouse
- Other

Performance Benchmark Methodology

To develop a performance benchmark based on the detailed data sources, EPA uses the following methodology:

Step 1: Determine the NAICS Codes for the Company's Business Units

EPA begins by determining the company's set of 4-digit NAICS codes for its different business units, based on data available in the company's 10-k and annual report. EPA then weighs the NAICS codes by their corresponding share of revenue to produce a list of sub-sectors for that company weighted by revenue. The examples in the following section assume that this set of revenue weightings is constant over the goal period, but this simplifying assumption is not necessary in practice. A set of revenue weightings, one for each sub-sector, is calculated as:

$$Sub\,sector\ Revenue\ Weighting = \frac{Sub\,sector\ Revenue}{Total\ Company\ Revenue} \times 100\%$$

Step 2: Choose the Appropriate Data Source

Based on the company's sub-sectors, the best available data source is chosen from IDM, CDM, or BLS.

Step 3: Estimate Starting and Ending CO_2 Intensities, by Fuel and by Sub-Sector

Fuel consumption estimates from the elected data source are combined with fuel-specific CO_2 emissions factors and sector output data to estimate emissions intensity for each sector, on both a historical and projected basis. For each NAICS sub-sector relevant to the company EPA calculates the historical and projected intensities:

1) Historical intensity for the company's base year by fuel (kg CO_2 per 1996 $ output)
2) Projected 2014 CO_2 Intensity by fuel (kg CO_2 per 1996 $ output)

Step 4: Interpolate Annual Intensities, by Fuel and by Sub-Sector

For data years between the historical and projected years, EPA estimates the annual CO_2 intensity, by fuel and by sub-sector, via linear interpolation.

Step 5: Calculate Annual Composite Intensities, by Fuel

This is a calculation of the fuel-specific annual intensities for the composite sector. It reflects the estimated fuel-specific emission intensity (kg CO_2 per $ output in 1996$) for a composite NAICS sector that is a revenue-weighted average of the company's sub-sectors:

$$Annual\ Composite\ Intensity(ACI) = \sum Sub\,\text{sec}tor\ Annual\ Intensity \times Sub\,\text{sec}tor\,\text{Re}venue Weighting$$

Step 6: Calculate Baseline Intensity Change for Composite Sector

This is the percentage change in emissions intensity, by fuel and total, for the composite sector, from the base to target years of the proposed goal. This result, summed over fuels, is used as the performance benchmark that climate-leading company goals need to exceed significantly.

Examples of Performance Benchmark Determination

Example 1: Single-Sector Company

Step 1: In this first example, a sample company reports that its business operations are entirely contained within a single NAICS 4-digit sector, 3371, Household and Institutional Furniture and Kitchen Cabinet Manufacturing. The negotiated base year was 2005, with a target year of 2012.

Steps 2-6: Fuel-specific emissions intensity estimates and projected change from the BLS-based model were calculated for the base and target years (See Table 1[6]).

Conclusion: The performance benchmark is determined to be an 8.91% improvement in CO_2 intensity from 2005 to 2012.

[6] Data shown in Tables 1, 3, and 4 have been rounded for presentation purposes.

Example 2: Multi-Sector Company

Steps 1-2: Each sector is identified first by its BLS industry number, then by the name, and finally by the NAICS code(s). The revenue weightings by BLS industry for a sample company, with a base year of 2002 and target year of 2010, are summarized in Table 2.

Table 1: Projected Goal Period Intensity Change, for a Single-Sector Company, by Fuel, in kg CO_2 per 1996$ Output

Fuel Input	Base Year: 2005	Goal Year: 2012	*Projected Goal Period Intensity Change*
Coal	0.003	0.002	***0.0%***
Petroleum	0.015	0.014	***-10.7%***
Electricity	0.087	0.082	***-6.0%***
Natural Gas	0.030	0.025	***-15.7%***
Total	***0.135***	***0.123***	***-8.91%***

Table 2: Revenue Weightings for a Sample Multi-Sector Company, by BLS Industry and NAICS Code

BLS Industry Number	NAICS Description	NAICS Code	Revenue Weighting
75	Ventilation, heating, air-conditioning, and commercial refrigeration equipment manufacturing	3334	30%
78	Other general purpose machinery manufacturing	3339	25%
92	Aerospace product and parts manufacturing	3364	40%
119	Monetary authorities and depository credit intermediation	521, 5221	5%

Steps 3-5: Total and annual projected emissions intensity change by sub-sector, with emissions intensities summed over fuels, in kg CO_2 per $ output (1996 $) and as a percentage, are shown in Table 3.

Table 3: Results by Sub-Sector, with Emissions Intensities Summed over Fuels, in kg CO_2 per 1996$ Output

NAICS Code	Base Year: 2002	Goal Year: 2010	Projected Emissions Intensity Change	Projected Change Per Year
3334	0.071	0.062	-0.125	-1.6%
3339	0.073	0.064	-0.120	-1.5%
3364	0.106	0.074	-0.303	-3.8%
521, 5221	0.009	0.009	0.008	0.1%

Step 6: Fuel-specific emissions intensity estimates and projected change from the BLS-based model were calculated for the base and target years (see Table 4).

Table 4: Composite Results for a Multi-Sector Company, by Fuel, in kg CO_2 per 1996$ Output

Fuel Input	Base Year:2002	Goal Year:2010	*Projected Goal Period Intensity Change*
Coal	0.001	0.001	***0.0%***
Petroleum	0.017	0.013	***-26.9%***
Electricity	0.048	0.039	***-18.3%***
Natural Gas	0.016	0.012	***-24.9%***
Total	***0.082***	***0.065***	***-21.5%***

Conclusion: The performance benchmark is determined to be a 21.5% improvement in CO_2 intensity from 2002 to 2010.

Use of Performance Benchmarks in Climate Leaders Goal Negotiations

In a goal discussion with a company, EPA utilizes the performance benchmark as an analytical basis for the approval of a goal. EPA rarely shares the performance benchmark with the company, preferring instead to negotiate based on what a company determines through its own internal scenario planning would be an aggressive goal. The performance benchmark thus does not limit a company's public commitment, but rather analytically informs EPA's decision as to whether or not to accept a particular goal. When a goal does not significantly exceed the benchmark, the company is asked to reevaluate its opportunities and work toward a more aggressive goal proposal. EPA also thoroughly examines the assumptions of the benchmark and the benchmark's applicability to the company. In a very few cases, EPA has determined that the benchmark may not be suitable for that particular company.

In addition, goal evaluations often consider 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 that might support a company's claims to climate leadership.

To date, the described methodologies have been utilized by EPA to negotiate 67 publicly announced GHG reduction goals, in sectors as diverse as cement, pulp & paper, aerospace, automotive, retail, and banking. All Climate Leaders goals announced to date have significantly exceeded the sector performance benchmark.

Benefits of Using a Performance Benchmark to Set Reduction Goals

Setting aggressive GHG reduction goals can galvanize reduction efforts at a company and often leads to the identification of many additional reduction opportunities. Additionally, an aggressive goal can help garner senior management attention and increase funding for internal GHG reduction projects. Corporate targets can also encourage innovation, improve employee morale, and help in the recruiting and retention of qualified employees.

The baseline estimates are also used to approximate total program GHG reductions by companies in the program, by subtracting expected corporate emissions assuming goal achievement from expected emissions assuming the baseline scenario. This number is then used as one tool for evaluating program effectiveness and demonstrating tangible program results.

EPA has determined that companies in the Climate Leaders program with announced goals have to date committed to reduce eleven million metric tons of carbon equivalent (MMTCE) annually from the overall program baseline.

Conclusion

EPA has designed a performance benchmarking model for use as a tool in negotiating aggressive GHG reduction goals under the Climate Leaders Partnership. The benchmarks are based on widely available energy use, sector output, and greenhouse gas data. The benchmarks serve to inform analytically EPA's acceptance of a GHG reduction goal proposal and aid EPA in evaluating program effectiveness, motivating corporate climate leadership, and achieving environmental benefits.

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Appendix: Sample Climate Leaders GHG Reduction Goals[7]

Partner Name	Greenhouse Gas Reduction Goal
3M	3M pledges to reduce total U.S. GHG emissions by 30 percent from 2002 to 2007.
American Electric Power	American Electric Power pledges to reduce total U.S. GHG emissions by 6 percent from 2001 to 2010. American Electric Power achieved its initial goal by reducing total U.S. GHG emissions by 4 percent from 2001 to 2006.
Anheuser-Busch Companies, Inc.	Anheuser-Busch Companies, Inc. pledges to reduce total U.S. GHG emissions by 5 percent from 2005 to 2010.
Ball Corporation	Ball Corporation pledges to reduce U.S. GHG emissions by 16 percent per production index from 2002 to 2012.
Boise Cascade	Boise Cascade pledges to reduce total U.S. GHG emissions by 10 percent from 2004 to 2014.
California Portland Cement Co.	California Portland Cement Company pledges to reduce U.S. GHG emissions by 9 percent per production index from 2003 to 2012.
Cummins Inc.	Cummins Inc. pledges to reduce global GHG emissions by 25 percent per dollar revenue from 2005 to 2010.
DuPont Company	DuPont Company pledges to reduce total global GHG emissions by 15 percent from 2004 to 2015.
General Motors Corporation	General Motors Corporation pledges to reduce total North American GHG emissions by 40 percent from 2000 to 2010. General Motors achieved its initial goal by reducing total North American GHG emissions by 23 percent from 2000 to 2005.
HSBC - North America	HSBC - North America pledges to reduce total U.S. GHG emissions by 10 percent from 2005 to 2010.
IBM Corporation	IBM pledges to reduce total global GHG emissions by 7 percent from 2005 to 2012. IBM achieved its initial goal by reducing total global energy-related GHG emissions by an average of 6 percent per year and PFC emissions by 58 percent from 2000 to 2005.
Intel Corporation	Intel Corporation pledges to reduce global GHG emissions by 30 percent per production unit from 2004 to 2010.
Johnson & Johnson	Johnson & Johnson pledges to reduce total U.S. GHG emissions by 14 percent from 2001 to 2010.
Raytheon Company	Raytheon Company pledges to reduce U.S. GHG emissions by 33 percent per dollar revenue from 2002 to 2009.
SC Johnson	SC Johnson pledges to reduce total U.S. GHG emissions by 8 percent from 2005 to 2010. SC Johnson achieved its initial goal by reducing total U.S. GHG emissions by 17 percent from 2000 to 2005.
Shaklee Corporation	Shaklee Corporation pledges to maintain net zero U.S. GHG emissions from 2006 to 2009.
St. Lawrence Cement	St. Lawrence Cement pledges to reduce global GHG emissions by 20 percent per ton of cementitious product from 2000 to 2012. St. Lawrence Cement achieved its initial goal by reducing global GHG emissions by 16 percent per ton of cementitious product from 2000 to 2006.
Staples, Inc.	Staples pledges to reduce total U.S. GHG emissions by 7 percent from 2001 to 2010.
Steelcase Inc.	Steelcase Inc. pledges to reduce U.S. GHG emissions by 40 percent per dollar sales from 2004 to 2009.
United Technologies Corporation	United Technologies Corporation pledges to reduce total global GHG emissions by 12 percent from 2006 to 2010. United Technologies achieved its initial goal by reducing global GHG emissions by 46 percent per dollar revenue from 2001 to 2006.

[7] See http://www.epa.gov/climateleaders/partners/ghggoals.html for complete list.