Calculating Indirect CO$_2$ GHG Emissions from Purchased Electricity Use

- A Primer for the IBM Sourcing Community
Contents

- Introduction: Greenhouse Effect
- Steps to Managing a Greenhouse Gas Inventory
- Sources: Documents Used for this Presentation
- GHG Protocol Corporate Standard
- Calculating Indirect Emissions (Electricity Use)
Introduction: Greenhouse Effect

• Gases such as Carbon Dioxide (CO₂) and methane absorb re-radiated heat in the ‘Greenhouse Effect’.

• The combustion of fossil fuels such as coal, oil and natural gas, releases CO₂ into the atmosphere, increasing this effect.

Source: Stephen Stretton - Gonville and Caius College, Cambridge
Global GHG / CO₂ Emissions (Gas, Sector)

**FIGURE 1**

GLOBAL GHG EMISSIONS BY GAS (2000)

- Carbon Dioxide: 77%
- Methane: 14%
- Nitrous Oxide: 8%
- HFCs, PFCs, SF₆: 1%

**Source:** World Resources Institute, Climate Analysis Indicators Tool (CAIT), version 3.0 (Washington, DC: World Resources Institute, 2006).

**FIGURE 2**

GLOBAL CO₂ EMISSIONS BY SECTOR (2000)

- Electricity and Heat: 32%
- Manufacturing and Construction: 13%
- Transportation: 17%
- Other Fuel Combustion: 10%
- Fugitive Emissions: 1%
- Industrial Processes: 3%
- Land-Use Change and Forestry: 24%

**Source:** World Resources Institute, Climate Analysis Indicators Tool (CAIT), version 3.0 (Washington, DC: World Resources Institute, 2006).

**Note:** Transportation emissions include international transport emissions, referred to as "international bunkers."
Simple Plan for Managing a GHG Inventory

➢ To Measure/Manage one’s Greenhouse Gases:

✓ Assign **resources** to the task and train them accordingly
✓ Select measurement protocol/GHG accounting **principles**
✓ Define organizational & operational inventory **boundaries**
✓ Identify **data sources** needed for selected boundaries
✓ **Calculate** total GHG emissions inventory
✓ Use compiled data to establish **objectives & targets**
✓ Publicly **report results**

Working 9 to 5 on Climate Change: An Office Guide

Samantha Putt del Plno
Pankaj Bhatia

Source: http://www.wri.org/publication/working-9-to-5-on-climate-change
A Service Sector Guide to GHG Management

Source: http://www.wri.org/publication/hot-climate-cool-commerce
WRI/WBCSD GHG Protocol

Corporate Standard

The GHG Protocol Corporate Standard provides standards and guidance for companies and other organizations preparing a GHG emissions inventory. It covers the accounting and reporting of the six greenhouse gases covered by the Kyoto Protocol — carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulphur hexafluoride (SF₆). It was designed with the following objectives in mind:

- To help companies prepare a GHG inventory that represents a true and fair account of their emissions, through the use of standardized approaches and principles.
- To simplify and reduce the costs of compiling a GHG inventory.
- To provide business with information that can be used to build an effective strategy to manage and reduce GHG emissions.
- To increase consistency and transparency in GHG accounting and reporting among various companies and GHG programs.

GHG Protocol – Available Calculation Tools

All Tools

Below is a complete listing of all tools provided by the GHG Protocol.

*Note to GHG Protocol tool users:* We have moved the GHG Protocol website to a new and improved online platform. If you created an account to download the tools prior to February 24th, 2011 please take a moment to re-register. Your previous log-in details will not work on the new platform. Thank you.

Downloads

Cross Sector Tools

These tools are applicable to many industries and businesses regardless of sector.

<table>
<thead>
<tr>
<th>Calculation Tool</th>
<th>Version</th>
<th>Guidance</th>
<th>Worksheet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allocation of Emissions from a Combined Heat and Power (CHP) Plant</td>
<td>1.0 (Sep 2006)</td>
<td>231 KB</td>
<td>50 KB</td>
</tr>
<tr>
<td>Emission Factors for Cross Sector Tools</td>
<td>1.2 (Sep 2011)</td>
<td>162 KB</td>
<td></td>
</tr>
<tr>
<td>GHG emissions from purchased electricity</td>
<td>4.3 (Aug 2011)</td>
<td>206 KB</td>
<td>1.4 MB</td>
</tr>
</tbody>
</table>

Organizations Publishing Existing Protocols

- WRI/WBCSD GHG Protocol
- EPA – Climate Leaders / National GHG Registry
- DOE 1605b
- The Climate Registry (TCR)
- California Climate Action Registry (CCAR)
- ICLEI – Local Governments for Sustainability
- Chicago Climate Exchange (CCX)
- ISO 14064
- UKWIR – Workbook for Quantifying GHG Emissions
The GHG Protocol Corporate Standard: *what is it?*

A widely-used standard for Corporate GHG accounting and reporting.

- The GHG Protocol Corporate Standard provides standards and guidance for any company or organization preparing a GHG emissions inventory.

- It covers the accounting and reporting of the six (6) greenhouse gases typically covered by existing regulations /protocols:
  - carbon dioxide \((\text{CO}_2)\)
  - methane \((\text{CH}_4)\)
  - nitrous oxide \((\text{N}_2\text{O})\)
  - hydrofluorocarbons \((\text{HFCs})\)
  - perfluorocarbons \((\text{PFCs})\)
  - sulphur hexafluoride \((\text{SF}_6)\).


- IBM follows the GHG Protocol in accounting for its Scope 1 and Scope 2 GHG emissions.
The GHG Protocol Corporate Standard: what’s in it?

**Guidance**
- Business goals and inventory design
- Accounting for GHG reductions
- Identifying GHG sources
- Managing inventory quality
- Verification of GHG emissions

**Standards**
- Organizational Boundaries
- Operational Boundaries
- Historic Datum
- Reporting GHG emissions

**Calculation Tools**
- Web-based, user-friendly, step-by-step guidance
- Build on IPCC methodologies
- Sector-specific tools developed in industry-led efforts (e.g. cement, pulp & paper, aluminum)

www.ghgprotocol.org
Accounting for Indirect Emissions from Purchased Electricity

This appendix provides guidance on how to account for and report indirect emissions associated with the purchase of electricity. Figure A-1 provides an overview of the transactions associated with purchased electricity and the corresponding emissions. Companies and electricity suppliers often exercise choice over where they purchase electricity, this provides them with an important GHG reduction opportunity (see Seattle City Light case study in chapter 4). Since scope 3 is optional, companies that are unable to track their electricity sales in terms of end users and non-end users can choose not to report these emissions in scope 3. Instead, they can report the total emissions associated with purchased electricity that is sold to both end- and non-end-users under optional information in the category “generation of purchased electricity, heat, or steam for re-sale to non-end users.”

Purchased electricity for own consumption

Emissions associated with the generation of purchased electricity that is consumed by the reporting company are reported in scope 2. Scope 2 only accounts for the portion of the direct emissions from generating electricity that is actually consumed by the company. A company that purchases electricity and transports it in a transmission and distribution (T&D) system that it owns or controls reports the emissions associated with T&D.
Seven Step Approach to Managing GHG Inventory

- Assign resources
  - Secure management support
  - Establish a team
  - Prepare a budget
- Design GHG inventory
  - Define inventory boundary
  - Determine sources of emissions
  - Factor in emissions from leased assets
- Collect data
  - Design efficient data management system
  - Select a base year
  - Obtain appropriate data
  - Ensure data quality
- Calculate emissions
  - Apply calculation tools
  - Guard against calculation errors
- Set target
  - Identify emission reduction opportunities
  - Decide on target type: absolute or intensity
  - Decide on target level
- Reduce emissions
  - Implement emission reduction activities
- Report results
  - Publicly report complete inventory information
USEPA’s eGRID Power Pool Regions (2009)
Ex. Emission Factor Table by eGRID Subregion

<table>
<thead>
<tr>
<th>Map No.</th>
<th>eGRID 2006 Subregion</th>
<th>eGRID 2006 Subregion Name</th>
<th>2004 Emission Rates</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>(lbs CO₂/MWh)</td>
</tr>
<tr>
<td>1</td>
<td>NEWE</td>
<td>NPCC New England</td>
<td>906.90</td>
</tr>
<tr>
<td>2</td>
<td>NYCW</td>
<td>NPCC NYC/Westchester</td>
<td>922.22</td>
</tr>
<tr>
<td>3</td>
<td>NYLI</td>
<td>NPCC Long Island</td>
<td>1,412.20</td>
</tr>
<tr>
<td>4</td>
<td>NYUP</td>
<td>NPCC Upstate NY</td>
<td>819.68</td>
</tr>
<tr>
<td>5</td>
<td>RFCE</td>
<td>RFC East</td>
<td>1,095.53</td>
</tr>
<tr>
<td>6</td>
<td>SRVC</td>
<td>SERC Virginia/Carolina</td>
<td>1,146.39</td>
</tr>
<tr>
<td>7</td>
<td>SRTV</td>
<td>SERC Tennessee Valley</td>
<td>1,494.89</td>
</tr>
<tr>
<td>8</td>
<td>SRMV</td>
<td>SERC Mississippi Valley</td>
<td>1,135.46</td>
</tr>
<tr>
<td>9</td>
<td>SRSO</td>
<td>SERC South</td>
<td>1,490.37</td>
</tr>
<tr>
<td>10</td>
<td>FRI</td>
<td>FRCC All</td>
<td>1,327.66</td>
</tr>
<tr>
<td>11</td>
<td>RCM</td>
<td>RFC Michigan</td>
<td>1,641.41</td>
</tr>
<tr>
<td>12</td>
<td>RFW</td>
<td>RFC West</td>
<td>1,556.39</td>
</tr>
<tr>
<td>13</td>
<td>MORE</td>
<td>MRO East</td>
<td>1,858.72</td>
</tr>
<tr>
<td>14</td>
<td>SRMW</td>
<td>SERC Midwest</td>
<td>1,844.34</td>
</tr>
<tr>
<td>15</td>
<td>MROW</td>
<td>MRO West</td>
<td>1,813.81</td>
</tr>
<tr>
<td>16</td>
<td>SPNO</td>
<td>SPP North</td>
<td>1,971.42</td>
</tr>
<tr>
<td>17</td>
<td>SPSO</td>
<td>SPP South</td>
<td>1,761.14</td>
</tr>
<tr>
<td>18</td>
<td>ERCT</td>
<td>ERCOT All</td>
<td>1,420.56</td>
</tr>
<tr>
<td>19</td>
<td>RMPA</td>
<td>WECC Rockies</td>
<td>2,035.81</td>
</tr>
<tr>
<td>20</td>
<td>AZNM</td>
<td>WECC Southwest</td>
<td>1,254.02</td>
</tr>
<tr>
<td>21</td>
<td>NWPP</td>
<td>WECC Northwest</td>
<td>971.10</td>
</tr>
<tr>
<td>22</td>
<td>CAMX</td>
<td>WECC California</td>
<td>878.71</td>
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<tr>
<td>23</td>
<td>HIMS</td>
<td>HICC Miscellaneous</td>
<td>1,456.17</td>
</tr>
<tr>
<td>24</td>
<td>HIOA</td>
<td>HICC Oahu</td>
<td>1,728.12</td>
</tr>
<tr>
<td>25</td>
<td>AKMS</td>
<td>ASCC Miscellaneous</td>
<td>480.10</td>
</tr>
<tr>
<td>26</td>
<td>AKGD</td>
<td>ASCC Alaska Grid</td>
<td>1,257.19</td>
</tr>
</tbody>
</table>

U.S. Average (Note: This factor should not be used for reporting): 1,363.00, 0.0305, 0.0198

Monthly Electricity Consumption is typically noted in kilowatt-hours (kWh) on the consumer’s utility bill.
Example: Electricity Use

1. Select Emission Factors (*Emission Rate*)

- Supplier in Seattle, Washington used 13,505 kWh of electricity in 2008 (13.5 MWh)
- Emissions Factors are geography specific
- For **Washington**, the supplier would use eGRID subregion NWPP – WECC Northwest:
  - 921.10 lb CO$_2$/MWh

Units used in equation:
emission rate (lbs/MWh) $\times$ electricity consumption (MWh) $\times$ metric tons/lbs conversion
### Example of Firm’s Annual Electricity Usage (2008)

<table>
<thead>
<tr>
<th>Billing Period</th>
<th>kWh Billed for Period</th>
<th># of Days in Period</th>
<th>kWh per day</th>
<th># of Days in Reporting Year</th>
<th>kWh for Reporting Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dec 16, 2007 - Jan 15, 2008</td>
<td>1,087</td>
<td>31</td>
<td>35</td>
<td>15</td>
<td>526</td>
</tr>
<tr>
<td>Jan 16 - Feb 15</td>
<td>1,007</td>
<td>31</td>
<td>32</td>
<td>31</td>
<td>1,007</td>
</tr>
<tr>
<td>Feb 16 - Mar 15</td>
<td>1,104</td>
<td>28</td>
<td>39</td>
<td>28</td>
<td>1,104</td>
</tr>
<tr>
<td>Mar 16 - Apr 15</td>
<td>1,242</td>
<td>31</td>
<td>40</td>
<td>31</td>
<td>1,242</td>
</tr>
<tr>
<td>Apr 16 - May 15</td>
<td>1,097</td>
<td>30</td>
<td>37</td>
<td>30</td>
<td>1,097</td>
</tr>
<tr>
<td>May 16 - Jun 15</td>
<td>1,174</td>
<td>31</td>
<td>38</td>
<td>31</td>
<td>1,174</td>
</tr>
<tr>
<td>Jun 16 - Jul 15</td>
<td>1,302</td>
<td>30</td>
<td>43</td>
<td>30</td>
<td>1,302</td>
</tr>
<tr>
<td>Jul 16 - Aug 15</td>
<td>1,187</td>
<td>31</td>
<td>38</td>
<td>31</td>
<td>1,187</td>
</tr>
<tr>
<td>Aug 16 - Sep 15</td>
<td>1,194</td>
<td>31</td>
<td>39</td>
<td>31</td>
<td>1,194</td>
</tr>
<tr>
<td>Sept 16 - Oct 15</td>
<td>1,027</td>
<td>30</td>
<td>34</td>
<td>30</td>
<td>1,027</td>
</tr>
<tr>
<td>Oct 16 - Nov 15</td>
<td>1,318</td>
<td>31</td>
<td>43</td>
<td>31</td>
<td>1,318</td>
</tr>
<tr>
<td>Nov 16 - Dec 15</td>
<td>1,275</td>
<td>30</td>
<td>43</td>
<td>30</td>
<td>1,275</td>
</tr>
<tr>
<td>Dec 16, 2008 - Jan 15, 2009</td>
<td>1,117</td>
<td>31</td>
<td>36</td>
<td>16</td>
<td>577</td>
</tr>
</tbody>
</table>

**Total Reported kWh for 2008**: 13,505
Example: Electricity Use

2. Determine Annual Consumption & Calculate GHG

\[ \text{CO}_2 \text{ Emissions} = 921.10 \text{ lb/MWH} \]

\[ \times 13.505 \text{ MWH/yr} / 2204 \text{ lb/metric ton} \]

\[ = 5.644 \text{ metric tons/yr} \]

**Basic Calculation:** Activity Data (Annual Consumption) \( \times \) Emissions Factor (from eGrid) = Total Annual Usage
REFERENCE MATERIAL
Additional Resources – Offices & Small Businesses

- A Model Environmental Management System for a Small Business
  - [http://www.epa.gov/sectors/pdf/finishing_emsm_all.pdf](http://www.epa.gov/sectors/pdf/finishing_emsm_all.pdf)

- Developing a Company-Wide GHG Inventory for a Small Business
  - [http://www.epa.gov/climateleaders/smallbiz/footprint.html](http://www.epa.gov/climateleaders/smallbiz/footprint.html)

- Working 9 to 5 on Climate Change: An Office Guide *(for small, office-based organizations)*

- Greenhouse Gas Emissions from a Typical Passenger Vehicle
  - [http://www.epa.gov/otaq/climate/420f05004.htm](http://www.epa.gov/otaq/climate/420f05004.htm)

- Oregon State University GHG Emissions Measurement & Reporting
  - [http://oregonstate.edu/sustainability/measurement-reporting](http://oregonstate.edu/sustainability/measurement-reporting)

- Calculating your GHG emissions from Company Flights

- Calculating your GHG emissions from Office Paper consumption

- Calculating your GHG emissions from Refrigerants

- Business Carbon Emissions Calculator
Additional Resources – cont’d

• Measuring Greenhouse Gas Emissions from Office Waste
  ➢ http://www.epa.gov/climatechange/wycd/waste/measureghg.html

• US Environmental Protection Agency (EPA) EMS Guidance
  ➢ http://www.epa.gov/ems/

• Environmental Management Systems in China
  ➢ http://www.unep.or.jp/ietc/focus/cn-EMS.doc

• The ACUPCC Reporting System (American Colleges & Universities)
  ➢ http://www.presidentsclimatecommitment.org/

• Guidance on how UK organizations should measure and report GHG

• EMS: An Implementation Guide for Small and Medium-Sized Organizations

• Environmental Management Systems in the Private Sector

• Implementing EMS in the Hotel Industry

• ISO 14001 Step-by-Step Implementation Guide Toolkit (Sample Pages)
  ➢ http://www.aecos.co.uk/Toolkit_Sample_Pages.pdf