Learning Objectives

• Conduct a simple measurement of any organization’s carbon footprint and identify “hot spots”
• Recommend the right measurement approach to fit the purpose and scope of more complex carbon measurement initiatives (e.g. supply chain)
• Be able to challenge other organization’s carbon footprint declarations
WidgetCo Case Study

Case Study Recap - WidgetCo

- **Global Manufacturing**
  - Chair manufacturing
  - Retail & Industrial customers in the US
- **Facilities**
  - Two manufacturing plants: one in Shanghai, China (50% joint-venture) and one in Michigan, USA (fully owned)
  - Two USA DCs for finished good distribution (California & Georgia)
  - 250 sq.ft. dedicated showroom at 2,500 BigDepot retail locations, representing 40% of retail sales
- **Transportation**
  - Dedicated 3PL (for all imported materials)
  - Retail channel: 80% private truck fleet, 10% air, 10% LTL
  - Industrial channel: 40% deliveries, 60% pick-ups at DC

Source: E. Blanco. MIT CTL 2009
Supply Chain Flows

Why is WidgetCo Interested in Carbon Footprint?

- Investors asking about it....

- Customers asking about it ...
  -- CEO attention

- Competitor, FerretCo, reported emissions in Carbon Disclosure Project
  -- 55,000 tons of CO₂
  -- 1.1 kgs of CO₂ per kg of product
  -- Wants to become carbon neutral
  -- Possibly labeling retail products
WidgetCo Emission Sources

WidgetCo Carbon Footprint Calculations

Facilities

\[ \text{Electricity Consumption} \times \text{Electricity Factor} + \text{Direct CO2 Emissions} \]

Transportation Method 1 (Ton-Miles)

Used for shared transportation assets:

\[ \text{Number of Shipments} \times \text{Distance} \times \text{Weight} \times \text{Mode Emission Factor} \]

Transportation Method 2 (Fuel Consumption)

Used for dedicated transportation assets:

\[ \text{Fuel Consumed} \times \text{Fuel Emission Factor} \]
### GHG Emission Factors

<table>
<thead>
<tr>
<th>Category</th>
<th>Process</th>
<th>Emission Factor (kg CO2e)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity</td>
<td>Electricity, USA (kWh)</td>
<td>0.596</td>
</tr>
<tr>
<td>Electricity</td>
<td>Electricity, Michigan (kWh)</td>
<td>0.703</td>
</tr>
<tr>
<td>Electricity</td>
<td>Electricity, China (kWh)</td>
<td>0.788</td>
</tr>
<tr>
<td>Transportation</td>
<td>Truck (ton-mile)</td>
<td>0.086</td>
</tr>
<tr>
<td>Transportation</td>
<td>Rail (ton-mile)</td>
<td>0.032</td>
</tr>
<tr>
<td>Transportation</td>
<td>Ocean (ton-mile)</td>
<td>0.016</td>
</tr>
<tr>
<td>Transportation</td>
<td>Air, Shorthaul (ton-mile)</td>
<td>2.528</td>
</tr>
<tr>
<td>Transportation</td>
<td>Air, Longhaul (ton-mile)</td>
<td>0.912</td>
</tr>
<tr>
<td>Fuel</td>
<td>Diesel (Gallon)</td>
<td>10.2</td>
</tr>
</tbody>
</table>

For most firms, cross sector tools that cover energy consumption and transportation are all that is needed.

*Usually refers to the six greenhouse gases covered by the Kyoto Protocol*
  - carbon dioxide (CO2)
  - methane (CH4)
  - nitrous oxide (N2O)
  - hydrofluorocarbons (HFCs)
  - perfluorocarbons (PFCs)
  - sulfur hexafluoride (SF6)
  - Other gases may need to be accounted for and reported separately

*Single unit of measure: CO2-equivalents*
  - Combined using 100-year “Global Warming Potential”
  - Regularly updated as part of the IPCC Assessment Reports
  - [https://www.ipcc.ch/publications_and_data/publications_and_data_reports.shtml](https://www.ipcc.ch/publications_and_data/publications_and_data_reports.shtml)

*“Carbon” is common word*
The GHG Protocol Emission Scopes

Scope 1: Direct emissions
Scope 2: Indirect emissions from electricity
Scope 3: Other indirect emissions

Case Study Questions

1. Calculate WidgetCo’s carbon footprint (Excel File)
   1. Correct emission factor for each WidgetCo supply chain activity
   2. Share to include in WidgetCo footprint (0-100%)
   3. Identify the emissions by scope

2. What did you include in your calculation and why? Explain to CEO and Board...

3. Will you recommend publicly disclosing WidgetCo’s carbon footprint? Why or why not? What about pledging to become carbon neutral or labeling your products?
WidgetCo Case Study Discussion

- Breakout in groups of three
- Agree on WidgetCo Carbon Footprint
  - One computer ready with the XLS
  - Emission Factors, Scopes, and Contribution
- Prepare to share your answers to the questions to the larger group

What is WidgetCo’s Carbon Footprint?
Which is the correct one?

![Graph showing CO2 emissions from different activities in supply chain and manufacturing.]

WidgetCo Emission Sources

![Diagram illustrating the emission sources for WidgetCo, including Shanghai Suppliers, Michigan Plant, and others.]

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Your Answers

Scope 3 Emissions Reported in the CDP

Courtesy of CDP. Used with permission.
Mechanics of Carbon Footprints

• Determine your organization boundary
  – Equity share, Financial or operational control
• Determine your operational boundary
  – Calculate Scope 1 and Scope 2 emissions
    • Minimum requirements
  – Identify Scope 3 emissions to include
    • Generally not required, but often included
• Gather data on operations
  – Apply appropriate emissions factors

Issues with Carbon Footprints

• Merging data from many sources
  – Facilities, transportation, procurement, etc.
• Data integrity
  – Do the numbers make sense?
  – Are there missing values?
• Data aggregation issues
  – Do air shipments have the same average weight as truck shipments?
• Finding the right emissions factors
  – Pay attention to units
  – Apply consistently
Tricks & Traps for Corporate Carbon Footprint

• Carefully define corporate boundaries
  – Read the GHG Protocol and understand it
  – Scope 1, 2 and 3 are a good framework
  – Relationship between internal vs. external stakeholders may affect your calculation of the carbon footprint

• Use the right data and emissions factors
  – Preferred accounting methods
  – Consistent choices of factors

• Absolute vs. relative measures

• Expect the carbon footprint to be refined over time.
  – Keep in mind as you share outside your organization or make reduction commitments
  – The primary goal is year-on-year comparisons
    • May require occasional restatements

Would you disclose?
Carbon Disclosure Project
767 Institutional investors with $92 trillion in assets

Why measure environmental footprint?

- Boundaries for internal may differ from external
Does it make sense to compare WidgetCo and FerretCo?
Supply chain and corporate comparison

<table>
<thead>
<tr>
<th>Scope</th>
<th>WidgetCo</th>
<th>FerretCo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corporate (Equity Share)</td>
<td>378,986</td>
<td>47,499</td>
</tr>
<tr>
<td>Per kg of sold product</td>
<td>4.51</td>
<td>0.95</td>
</tr>
<tr>
<td>Disclosed (Equity Share)</td>
<td>414,824</td>
<td>55,219</td>
</tr>
<tr>
<td>Per kg of sold product</td>
<td>4.94</td>
<td>1.10</td>
</tr>
<tr>
<td>Supply Chain</td>
<td>581,724</td>
<td>365,019</td>
</tr>
<tr>
<td>Per kg of sold product</td>
<td>6.93</td>
<td>7.30</td>
</tr>
</tbody>
</table>

Increasing need for a broader view of emissions

Figure removed due to copyright restrictions. See the lecture video for further details.

- Apple has been voted the best supply chain company for 6 years straight by Gartner Inc.
Many sectors would have less than 25% of their total GHG footprint represented by Scope 1 and 2 estimates.

Expanding the GHG Protocol

Figure 1.1 Overview of GHG Protocol scopes and emissions across the value chain

CDP Supply Chain Started in 2008

A. Response rate over the years

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of suppliers contacted</th>
<th>Response rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>1402</td>
<td>51%</td>
</tr>
<tr>
<td>2010</td>
<td>1853</td>
<td>54%</td>
</tr>
<tr>
<td>2011</td>
<td>4224</td>
<td>44%</td>
</tr>
<tr>
<td>2012</td>
<td>6315</td>
<td>38%</td>
</tr>
<tr>
<td>2013</td>
<td>5659</td>
<td>51%</td>
</tr>
</tbody>
</table>

B. Number of supplier requests by each member

<table>
<thead>
<tr>
<th>Number of suppliers contacted by member company</th>
<th>17</th>
</tr>
</thead>
<tbody>
<tr>
<td>More than 100</td>
<td>9</td>
</tr>
<tr>
<td>150-200</td>
<td>9</td>
</tr>
<tr>
<td>100-150</td>
<td>7</td>
</tr>
<tr>
<td>75-100</td>
<td>6</td>
</tr>
<tr>
<td>50-74</td>
<td>11</td>
</tr>
<tr>
<td>25-50</td>
<td>9</td>
</tr>
<tr>
<td>Less than 25</td>
<td>9</td>
</tr>
</tbody>
</table>

Courtesy of CDP. Used with permission.

More pressure leads to more responses

<table>
<thead>
<tr>
<th>N=4256</th>
<th>N=5039</th>
<th>N=2018</th>
<th>N=2956</th>
</tr>
</thead>
<tbody>
<tr>
<td>54%</td>
<td>23%</td>
<td>18%</td>
<td>6%</td>
</tr>
<tr>
<td>2%</td>
<td>4%</td>
<td>5%</td>
<td>2%</td>
</tr>
<tr>
<td>44%</td>
<td>73%</td>
<td>77%</td>
<td>92%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Answered Questionnaire</th>
<th>Declined to Participate</th>
<th>No Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>One</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Two</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Three</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Four or more</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Courtesy of CDP. Used with permission.
Value Chain vs. Product

- Aggregates emissions for the supply chain
  - Broad in scope, aggregated data
- Product standard
  - Specific to one product, measured per unit

What about products?

3.4 grams

3.4 grams, just over 2 minutes of TV

More than 7 grams


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Courtesy of Gregory, J., R. Kirchain, and T. Montalbo, Materials Systems Laboratory, MIT. Used with permission.
Does it make sense to be carbon neutral?

- Ongoing expense to purchase offsets
  - 550,000 tons * $10-15/ton = $5.5-8.25 million
- Carbon footprint generally reported before factoring in offsets
- Fraud/Corruption/Misleading
  - Fiji Water sued over forward crediting

Carbon Offsets

- Voluntary market of $569 million in 2011
  - World Bank Carbon Finance Report 2012
- Several certification schemes
  - Gold Standard, Voluntary Carbon Standard, etc.
- Voluntary Carbon Standard Principles
  - Additional
  - Real
  - Measurable
  - Permanent
Why measure environmental footprint?

<table>
<thead>
<tr>
<th>Focus</th>
<th>Internal</th>
<th>External</th>
</tr>
</thead>
<tbody>
<tr>
<td>Driver</td>
<td>CSR Metrics</td>
<td>CSR Report</td>
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<tr>
<td></td>
<td>Hotspot Analysis</td>
<td>Government</td>
</tr>
<tr>
<td>Corporate</td>
<td></td>
<td>Investor/Customer</td>
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<tr>
<td></td>
<td></td>
<td>Pressure</td>
</tr>
<tr>
<td>SC / Product</td>
<td>Supplier Selection</td>
<td>Brand</td>
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<tr>
<td></td>
<td>Sourcing/Process</td>
<td>Labeling</td>
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<tr>
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<td>Decisions</td>
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<tr>
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<td>Supply Chain/Product</td>
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</tr>
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<td></td>
<td>Design</td>
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</table>

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