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Calculating and Reducing Your Carbon Footprint

by Paul Jakubski, Director of Environmental and Safety, Dow Jones & Co. Inc.

With all the talk in the media today of global warming and "going green" by lowering your carbon footprint, exactly how do you calculate your carbon footprint? Although currently there is no government mandatory standard to use in the United States, there is an international, voluntary standard that stands out among others and has been accepted by most major corporations and non-governmental organizations (NGOs) as the default standard: The Greenhouse Gas (GHG) Protocol (www.ghgprotocol.org).

This standard was developed by the World Resources Institute and the World Business Council for Sustainable Development, whose working committee includes organizations such as the World Wildlife Fund, The United Nations, Ford, BP, PricewaterhouseCoopers, and the U.S. EPA. This accounting system is used by the European Emissions Trading program and in California's voluntary Climate Action Registry Protocol. Recognized by EPA (and used in a slightly modified version in EPA's voluntary Climate Leaders Program), most major corporations such as GE, Johnson & Johnson, Wal-Mart, and News Corporation are using the GHG Protocol.

Adding pressure to report your carbon footprint, the EPA is expected to require businesses to begin reporting their greenhouse gases in 2009.

What Do I Calculate?

When it comes to calculating your carbon footprint, there are basically two types to choose from: (1) calculating what you can operationally or financially control, or (2) calculating the entire life cycle of your business. The life cycle analysis is usually focused on a particular product and is sometimes called the product or supply chain carbon footprint.

This article will focus on the operational control carbon footprint, which is the type that most companies report publicly. For a list of companies that have publicly reported their carbon footprints, go to the Carbon Disclosure Project (CDP) reference at the end of this article. The CDP is the largest repository in the world for footprint data, formed by a number of financial investment companies, including Merrill Lynch and Goldman Saks. The CDP uses the GHG Protocol for reporting.

The first task in developing your carbon footprint is to set your boundaries. Determine what you can operationally control (such as owned and/or leased buildings, vehicles, and equipment) so that they can be included in the calculations.

The GHG Protocol uses five guiding principles when developing a footprint:

- completeness
- consistency
- relevance
- accuracy
- transparency

Highlighting two of these principles, consistency is important because a consistent methodology will be needed as your operations change over time. Transparency is important so that you can disclose assumptions and make references for a clear audit trail.

The GHG protocol requires six gases to be reported: (1) carbon dioxide (CO_2), (2) methane (CH_4), (3) nitrous oxide (N_2O), (4) hydrofluorocarbons (HFCs), (5) perfluorocarbons (PFCs), and (6) sulfur hexafluoride (SF_6). These are the same six gases that were identified during the development of the Kyoto Protocol. Of the six, only CO_2, CH_4, N_2O (all three are products of combustion) and HFCs (refrigerants) would typically apply to printing operations.

The GHG Protocol divides the types of emission sources into three scopes. **Scope 1** sources are direct emissions from the facility, such as:

- Emergency generators
- Gas boilers/water heaters
- Company-owned or leased vehicles
- Propane forklifts/clamp trucks
- Refrigerants (HFCs)

Scope 2 is the electricity purchased for your facility. Both Scope 1 and Scope 2 must be included in your calculations per the GHG Protocol.

Scope 3 covers the indirect emissions from your operations, such as:

- Product materials produced by your suppliers (newsprint/paper, ink, etc.)
- Contractor delivery vehicles
- Employee commuting to/from work
- Business air travel

Scope 3 emissions are optional and are not required to be reported per the GHG Protocol. Some have argued that including these would be double counting your emissions, since your Scope 3 emission sources could be considered somebody else's Scope 1 sources. However, many businesses have chosen to include some Scope 3 emissions in their cal-

culations. For example, News Corporation chose to include business air travel.

Completing Scope 3 emissions would, by default, get you most of the information you would need to develop your life cycle or product carbon footprint, since it includes a review of your suppliers as well as disposal emissions.

Sample Calculations

Let's take a look at some examples of calculating footprints in different scopes.

Scope 1 Example: Emergency Generators

Usage (gal) × CO_2 emission factor (kg CO_2/gal) × 0.001 metric tons/kg + (Usage (gal) × CH_4 emission factor (kg CH_4/gal) × 0.001 metric tons/kg) × 21 GWP + (Usage (gal) × N_2O emission factor (kg N_2O/gal) × 0.001 metric tons/kg) × 310 GWP = CO_2e Emissions (metric tons)

Since emergency generators (and most petroleum-based combustion) give off CO_2, CH_4, and N_2O, the first line is the equation for the CO_2 component, the second is the CH_4 component, and the third is the N_2O component of the emission. The emission factors vary depending on fuel type and can be found in the GHG Protocol documents on its website. The GHG Protocol website also provides sample Excel spreadsheet calculators you can download and use.

The Global Warming Potential (GWP), as defined in the GHG Protocol, is a factor describing the radiative forcing impact (degree of harm to the atmosphere) of one unit of a given GHG relative to one unit of CO_2. For example, see Figure 1 for some gases and their GWP.

This chart shows that methane (CH_4) is 21 times more harmful than CO_2, nitrous oxide (N_2O) is 310 times more harmful, and the HFC-23 refrigerant is almost 12,000 times more harmful! When calculating carbon emissions, these other gases need to be included in the calculations and related to an "equivalent" CO_2, hence the "e" after CO_2e.

Scope 2 Electricity Calculations Are Similarly Derived:

Usage (kWh) × CO_2 emission factor (lbs CO_2/kWh) / 2204.62 lbs/metric ton + (Usage (kWh) × CH_4 emission factor (lbs CH_4/kWh) / 2204.62 lbs/metric ton) × 21 GWP + (Usage (kWh) × N_2O emission factor (lbs CH_4/kWh) / 2204.62 lbs/metric ton) × 310 GWP = CO_2e Emissions (metric tons)

The emissions factors for electricity can be found using the eGRID emission factors developed by the U.S. EPA. These factors are regionally derived based on the mix of electricity sources used (i.e., coal, gas, nuclear, and renewables) in the region. Figure 2 (on the next page) shows how the regions are divided, with each region having a unique factor.

Electricity emissions will most likely be the majority of your facility emissions.

Note that since the eGRID factors are regional, you may want to ask your local utility if they have specific CO_2e emission intensity data to get a more accurate factor (per GHG Protocol). This is especially true if your utility recently added new renewable sources to their grid, such as solar, wind, or hydro. The CO_2e intensity data should be in the form of lbs. CO_2e/kWh from your utility so you can apply it for your usage.

Scope 3: Emissions

See Figure 3 for an example of how to calculate business air travel, using a spreadsheet template from the GHG Protocol:

As you can tell, the shorter flights have a larger effect on the emissions than longer flights. This is because a large part of CO_2 emissions from air travel occurs during takeoff and landing, therefore emissions per mile traveled for short flights are higher than emissions for long flights.

Including Scope 3 sources is a decision that each business will need to make.

Gases and Their Global Warming Potential

CO_2*	1
CH_4*	21
N_2O*	310
HFC-23	11,700
HFC-32	650
HFC-125	2,800
HFC-134a	1,300
HFC-143a	3,800
HFC-152a	140
HFC-236fa	6,300

Figure 1. Gases and their respective Global Warming Potentials

eGRID Emission Factors

Figure 2. eGRID Emission Factors

Sample Calculation of Scope 3 Emissions

Description	A Distance Traveled	B Unit	C CO_2 emission factor kg/unit	D kg/Unit	E CO_2 emissions in kg	F CO_2 emissions in metric tons
					E=AxC	
Short Flight (<311 miles)		mile	0.24	kg/mile	0	0.00
Medium Flight (<994 miles)		mile	0.19	kg/mile	0	0.00
Long Flight (>994 miles)		mile	0.18	kg/mile	0	0.00

Figure 3. A sample calculation of Scope 3 Emissions

Other considerations when developing your footprint is that the baseline year of your footprint will change if you divest businesses, or outsource/insource activities in Scope 1 if not reported in Scope 3 (i.e., delivery of your product). The baseline footprint will not change for any "organic" growth or declines (i.e., production changes, office closures, etc.). Those changes would be counted for the year in which they occurred. You can't use divestures or outsourcing to show reductions in your footprint!

Companies should also consider securing an independent party to audit your footprint calculations. This is part of the transparency principle and is expected under the GHG protocol.

Finally, carbon footprints are normally reported in absolute numbers, but you should consider developing a carbon footprint intensity to normalize your data for changes in production or sales. For example, you can determine your carbon footprint intensity as CO_2e/ton of newsprint or paper consumed, or CO_2e/sales, or CO_2e/employee.

Potential Energy Savings

Source	Typical Energy Savings	Average Payback	Average ROI
Lighting	12–66%	2.5 years	40%
HVAC	10–30%	3.9 years	26%
Air Compressors	20–50%	No data	No data
Motors/Drives	**25–75%**	**2.5 years**	**40%**
Natural Gas Chillers	30%	No data	No data
Reflective Roofing	**20–70%**	**No data**	**No data**
Adjusting Power Factor	5–20% (cost savings)	No data	No data

Figure 4. Typical energy sources and potential energy savings

Reducing Your Footprint

The Newspaper Association of America (NAA) developed an "Energy Management in the Newspaper Industry" (2003) document that could apply to many printers. Figure 4 shows a summary of typical energy sources and potential energy savings.

The table shows that there are four main drivers of energy usage in a printing operation: lighting, heating, ventilation and air conditioning (HVAC), air compressors, and the motor drives used in the presses. Efforts should be focused on reducing the energy used by these four groups of equipment in your plant.

Here are a few simple, low-cost energy reduction solutions:

- Audit your plant for energy efficiencies using local universities (see the Industrial Technologies Program link in the references section).
- Remove bulbs (and ballasts) where not needed.
- Shut off equipment when not in use (PCs, machine shop equipment).
- Insulation, weather stripping, and window film coverings still work!
- Use LED, T8s/T5s, or CFL lighting (no incandescent bulbs!)
- Use occupancy sensors (dual infrared/ultrasonic work best).
- Increase thermostat one degree in summer, decrease one degree in winter.
- Buy variable speed drive motors when replacing old standard motors—a Six Sigma project at Dow Jones showed a 21% energy savings when running a VSD compressor during non-production times and 12% savings in production mode.
- Maintain your HVAC system (change filters, lube bearings, clean coils).

- Plug compressed air leaks—an energy audit at one of our plants found we were losing 15% of our air due to leaks, and that one quarter-inch hole can cost us $8,700/year.
- Reduce your hot water heater temperature to 115°F.
- Schedule battery charging or baling equipment only during off-peak periods (typically 10pm–8am).
- Review number of motors used on a newspaper press—a Six Sigma project showed that the most energy efficient setup was running two more motors than the number of sheets being run, saving us an estimated $100,000/year.
- Review your local utility rebate offers to new energy efficient projects.
- Buy "EnergyStar" rated equipment.

Paul's department is responsible for developing environmental, safety and energy management guidelines, procedures and policies for the company's seventeen *Wall Street Journal/Barron's* printing plants and eight Ottaway community newspapers, along with numerous office locations. He is also the secretary of Dow Jones' Corporate E&S Committee, chaired by the Vice President of Production. Paul can be reached at 609-520-4865 or paul.jakubski@dowjones.com.

References

The following references were used to develop this article that you can also use to help develop and reduce your carbon footprint:

- **GHG Protocol** (www.ghgprotocol.org)
- **CA Climate Action Registry** (www.climateregistry.org)
- **Carbon Disclosure Project** (www.cdproject.net)
- **Environmental Leader** (www.environmentalleader.com)
- **EPA Climate Leaders** (www.epa.gov/climateleaders)
- **EnergyStar** (www.energystar.gov)
- **LEED** (www.usgbc.org/DisplayPage.aspx?CategoryID=19)
- **Industrial Technologies Program (DOE)** (www1.eere.energy.gov/industry)
- **Sustainable Green Printing (SGP) Partnership** (www.sgppartnership.org)
- **News Corp Energy Initiative** (www.newscorp.com/energy/index.html)
- **Wall Street Journal Environmental Capital Blog** (http://blogs.wsj.com/environmentalcapital)