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Robert M. Kerr Food & Agricultural Products Center

FOOD TECHNOLOGY FACT SHEET

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Carbon Footprinting for the Food Industry

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Carbon footprinting in the food industry is an activity that determines the greenhouse gas (GHG) emissions of a food processor. A carbon footprint is normally reported in units of mass (e.g. tons) of carbon dioxide (CO2) equivalent per functional unit (e.g. kg or liter of goods sold) (PAS2050, 2008). The purpose of this fact sheet is to assist food industry personnel in calculating a carbon footprint for their processing facility and products. The importance of establishing a carbon footprint for a food processor is described in the related fact sheet FAPC 172, Carbon Strategy for the Food Industry (Bowser, 2010).

Carbon Footprinting

Calculating a carbon footprint requires three basic steps:

1. Define the operational boundary
2. Collect data
3. Calculate the carbon footprint

The remainder of this fact sheet will focus on the three steps of carbon footprinting. A step-by-step example of identifying and calculating a carbon footprint for a food processor is presented.

Operational Boundary

The first step in carbon footprinting is to define the operational boundary. An operational boundary encompasses and helps to identify the activities that emit GHGs. Emissions are grouped into the following categories (often called "scopes" by authorities on the topic):

1. Direct
2. Indirect
3. Optional

Direct GHG emissions are completely under the control of the company. Burning natural gas in an on-site boiler and using fuel oil for heating are examples. Indirect GHG emissions are the result of activities that the food manufacturer can shape, but cannot directly control, such as purchased electricity generated by a power plant. Optional GHG emissions come from sources that a food manufacturer has almost no control over, such as the type of vehicle an employee chooses to drive or how far the employee drives to work. Optional GHG emissions are rarely included in a carbon footprint.

Data Collection

Once the operational boundary is defined and GHG sources identified, the next step is to collect data. Data collection can be by direct measurement or estimation. Direct measurement requires the use of data logging equipment and sensors to detect and measure GHGs. This method is costly and time consuming. Most food processors use formulas to estimate their GHG production based on data obtained from utility and fuel bills. The data includes the amounts of all significant fuels and energy used in the facility over a given time period or for a specific product.

Calculation

Calculation tools are used to estimate the amounts of GHGs produced based on the data collected. The Greenhouse Gas Protocol Initiative (www.ghgprotocol.org) maintains an excellent collection of calculation tools and instructions on how they are used. The calculation tools are available on its website as a free download. Other simple spreadsheet calculators (designed by the

World Resources Institute) are available for download at: http://www.cleanair-coolplanet.org/OfficeFootprint.php.

Example

The carbon footprint of a fictitious Oklahoma barbecue sauce producer "Still-BBQ" is calculated as an example. The operational boundary for Still-BBQ is for manufacturing alone and does not include raw materials, distribution, retail, consumer and disposal activities. First, the basic carbon footprint due to direct and indirect GHG emissions will be determined. Next, the carbon footprint for individual products will be estimated.

Direct GHG Emissions

Still-BBQ has collected all of its energy-related bills for an entire year and extracted the data on energy consumption for its operations. Direct GHG emissions from combustion of fossil fuels at the facility are shown in table 1. Based on the energy source and amounts consumed, a spreadsheet calculator from World Resources Institute (2009a) was used to estimate the GHG emissions. Annual GHG emissions equivalent (shown in table 1) for direct emissions for Still-BBQ is approximately 39.3 metric tons.

Table 1. Direct GHG emissions cataloged for Still-BBQ.

Row #	Purpose	Energy Source	Annual Amount	Units	GHG CO_2 Equivalent (metric tons)*	Process or Facility use
1	Space heating	Natural gas	1,850	Therm	9.864	Facility
2	Hot water	Natural gas	520	Therm	2.773	Process
3	Steam	Fuel oil	725	Gallon	8.092	Process
4	Corporate automobile	Gasoline	830	Gallon	7.163	Facility
5	Yard Fork Truck	Diesel	1,120	Gallon	11.384	Process
6				TOTAL	39.276	

** Calculated using the GHG Protocol tool for stationary combustion, version 4.0 (World Resources Institute, 2009a).*

Indirect GHG Emissions

Still-BBQ has annual indirect GHG emissions based on its use of purchased electricity generated from a nearby power plant shown in table 2. Because of separate metering functions, Still-BBQ has indirect GHG emissions data for the facility and process operations. Considering the energy source and amounts consumed, a spreadsheet calculator from World Resources Institute (2009b) was used to estimate the GHG emissions. Total GHG emissions equivalent for indirect emissions for Still-BBQ are estimated at 125.4 metric tons (see table 2). Optional GHG emissions are ignored in this example.

Annual Carbon Footprint

The total annual carbon footprint for Still-BBQ for the given year is the sum of the direct and indirect estimates of GHG emissions given in tables 1 and 2, or 39.3 + 125.4 = 164.7 metric tons. Clients and stakeholders of Still-BBQ have requested a further breakdown of the carbon footprint according to products produced.

Carbon Footprint of Individual Products

Still-BBQ can estimate a carbon footprint for each of its five, unique products by identifying and defining its share of GHG produced by facility operation and product processing.

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Extension carries out programs in the broad categories of agriculture, natural resources and environment; home economics; 4-H and other youth; and community resource development. Extension staff members live and work among the people they serve to help stimulate and educate Americans to plan ahead and cope with their problems.

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Table 2. Indirect GHG emissions for Still-BBQ resulting from purchased electricity.

Row #	Purpose	Energy Source	Annual amount	Units	GHG CO_2 Equivalent (metric tons)* **
1	Facility (lights, HVAC, computers, phones, alarms)	Electric utility with coal-fired generation **	20,080	kW-hr	83.706
2	Process (motors, refrigeration, fans, controls, lights)	Electric utility with coal-fired generation **	10,610	kW-hr	41.705
3				TOTAL	125.411

**Calculated using the GHG Protocol tool for purchased electricity, version 4.0 (World Resources Institute, 2009b).*
*** Electric utility region is assumed to be SPP South (Southern Power Pool, southern section)*

Facility Operation

Production time for each product (listed in table 3) is used to equitably spread the annual GHG emissions associated with facility operations across products. In this example, production time for products is relative, compared to a base product, BBQ sauce. The portion of the carbon footprint associated with the facility consists of rows 1 and 4 in table 1 and row 1 in table 2. Summing the GHG equivalent for the identified facility-based emissions yields 9.864 + 7.163 + 83.706 = 100.733 metric tons of CO2 equivalent. This figure is used in table 3 (column C) to calculate the GHG emissions due to facility use for each product.

Table 3. GHG emissions associated with facility operation for each product manufactured by Still-BBQ.

	A	B	C
Product	Production time compared to base product	% of total facility GHG emissions assigned (A/Sum of Column A) x 100	GHG emissions due to facility use (metric tons) (Column B/100) x 100.733
BBQ Sauce (base product)	1.0	35.7	36.0
Pickles	0.8	28.6	28.8
Dry rub	0.5	17.9	18.0
Marinade	0.3	10.7	10.8
Low-carb BBQ Sauce	0.2	7.1	7.2
SUM	2.8	100.0	100.8

Processing

Process energy consumption is used to estimate the unique GHG emissions associated with the manufacturing of each product. For example, one product might require additional grinding and refrigeration steps compared to another product, which translates to more energy usage (and more GHG emissions). Table 4 is an example of how process energy usage data might be collected or estimated and assigned to each product for the example company, Still-BBQ. Table 4 assumes that the owner can estimate the energy used to process each product compared to the base product, BBQ sauce. The portion of the carbon footprint associated with the process consists of rows 2, 3 and 5 in table 1 and row 2 in table 2. Summing the GHG equivalent for the identified process-based emissions yields: 2.773 + 8.092 + 11.384 + 41.705 = 63.954 metric tons of CO_2 equivalent. This figure is used in table 4 (column E) to calculate the GHG emissions due to process use for each product.

Table 4. GHG emissions associated with process energy usage for each product manufactured by Still-BBQ.

	A	B	C	D	E
Product	Process energy use compared to base product	Production time compared to base	Process energy use x production time A x B	% of total process GHG emissions estimated based on process energy used (C/Sum of Column C) x 100	GHG emissions due to processing (metric tons) (Column D/100) x 63.954
BBQ Sauce (base product)	1.0	1.0	1.00	37.9	24.2
Pickles	1.2	0.8	0.96	36.4	23.3
Dry rub	0.2	0.5	0.10	3.8	2.4
Marinade	1.0	0.3	0.30	11.4	7.3
Low-carb BBQ Sauce	1.4	0.2	0.28	10.6	6.8
SUM			2.64	100.0	64.0

Summary of GHG for Products

A summary of the estimated annual GHG emissions associated with each product produced by Still-BBQ is given in table 5. The data in columns A and B of table 5 are taken from tables 3 and 4, columns C and E, respectively. GHG emissions are estimated per 1,000 cases of product for convenience. Food companies should be prepared to report their carbon footprint data in a variety of units, since clients and stakeholders request specific units that are meaningful to their business model.

Table 5. Summary of annual GHG emissions estimated for each product produced by Still-BBQ.

	A	B	C	D	E
Product	Annual GHG emissions due to facility use (metric tons), taken from table 3	Annual GHG emissions due to processing (metric tons), taken from table 4	Annual GHG emissions estimate for product (metric tons) A + B	Annual cases produced	Annual GHG emissions estimate per 1,000 cases of product (metric tons) (C/D) x 1,000
BBQ Sauce	36.0	24.2	60.2	5,051	11.92
Pickles	28.8	23.3	52.1	4,650	11.20
Dry rub	18.0	2.4	20.4	3,002	6.80
Marinade	10.8	7.3	18.1	1,475	12.27
Low-carb BBQ Sauce	7.2	6.8	14.0	1,108	12.64
SUM	100.8	64.0	164.8	15,286	54.82

Conclusion

Carbon footprinting is a method used to determine the amount of GHG emitted by a food processor as a result of manufacturing. Food processors can collect and process data using the method outlined in the provided example to determine their carbon footprint. Carbon footprint information can be used to help make decisions on how to manage and reduce GHG emissions.

Carbon footprinting also may be used to calculate the GHG produced by activities that are upstream and downstream of the manufacturing process (farming, distribution, retail, consumer use and disposal). Knowledge of GHG sources beyond the manufacturing scope can be useful to help identify opportunities to reduce GHG emissions in the overall lifecycle of a product. This activity will be the subject of a future fact sheet.

More Information

If you would like guidance calculating the carbon footprint of your food manufacturing facility or products, please call the Robert M. Kerr Food & Agricultural Products Center (405-744-6071) or e-mail fapc@okstate.edu to request assistance.