

Honey Carbon Footprint Calculator User Guide

Developed at the University of California, Davis¹ and KJKramer Consulting

Table of Contents

Chapter 1. Introduction	2
Chapter 2. The honey carbon footprint calculator	3
Chapter 4. Beekeeping and honey production	6
Chapter 5. Honey transport	10
Chapter 6. Honey packaging	11
Chapter 7. Total results	14

¹ For more information, contact Dr. Alissa Kendall, amkendall@ucdavis.edu; or Dr. Sonja Brodt, sbrodt@ucdavis.edu

Honey Carbon Footprint Calculator User Guide

Chapter 1. Introduction.

This manual provides instructions and supporting documentation for use of the UC Davis calculator to assess the carbon footprint of honey. The remaining chapters in the manual cover the following topics:

- Chapter 2 - a brief description of the honey carbon footprint assessment method used in this calculator;
- Chapter 3 - instructions on how to navigate the calculator;
- Chapter 4 - a description of informational inputs required of the user in order to calculate the carbon footprint of all *beekeeping* activities associated with honey production, along with an explanation of the outputs produced by the calculator;
- Chapter 5 - a description of informational inputs required of the user in order to calculate the carbon footprint of *transport of honey from beekeepers to packing facilities*, along with an explanation of the outputs produced;
- Chapter 6 - a description of informational inputs required of the user in order to calculate the carbon footprint of honey *packing*, along with an explanation of the outputs produced; and
- Chapter 7 - an overview of the overall outputs produced.

Honey Carbon Footprint Calculator User Guide

Chapter 2. The honey carbon footprint calculator.

This manual describes a model, or calculator, to assess the carbon footprint of honey. The term “carbon footprint” is used to describe the sum of all greenhouse gases emissions that occur throughout the steps required to produce and process honey. In addition to emissions resulting directly from beekeeping, transport, and packing activities (which generally stem from the burning of fossil fuels like gasoline or diesel), it also includes the greenhouse gases that are emitted in the production chain of products or services required for honey production, such as the production of the electricity from coal, pest control agents, feed materials, packaging materials, and other materials purchased by beekeepers. National and international databases are used to characterize the greenhouse gas emissions related to these inputs.

The following activities are assessed for their greenhouse gas emissions:

- **HONEY PRODUCTION:**
 - Feeding
 - Pest control: treatment for nosema and varroa.
 - Transportation
 - Pollination
 - Honey
 - Supply purchases
 - Honey extraction: energy use
- **HONEY TRANSPORTATION, FROM BEEKEEPER TO PROCESSOR**
- **HONEY PACKING:**
 - Packaging materials
 - Energy use in filling operation

Besides calculating a total carbon footprint, expressed in kg CO₂-equivalents per kg or lb of honey, the output-sheets in this calculator also show the relative contributions of CO₂-equivalent emissions from specific activities such as feeding, pest management, extraction and transport, and packaging.

Description of the Calculator

The Carbon Footprint Calculator was developed in Microsoft Excel, and is compatible with Excel versions 1997 and newer. The Calculator requires some basic familiarity with Excel, in so far as a user needs to navigate the model and enter data where prompted. The model includes *macros*. Macros are programs that run within Excel and are included to make the model as user-friendly as possible. However, Macros need to be “enabled” in Excel through Excel’s security settings. Depending on the version of Excel you have, the process for selecting security settings is different.

Honey Carbon Footprint Calculator User Guide

If you have Microsoft Office 2003 or older, then in general, you will be able to access security settings for Excel versions older than 2007 by going to the “Tools” options on the toolbar at the top of your Excel window, select “Options” in the “Tools” menu, then the “Security” tab in the “Options” dialogue box. The “Security” tab will have a button or check box for “Macros”. Your default setting is likely “High” security. If you select “Medium” you will be able to “Enable Macros” when you open the Honey Carbon Footprint Calculator. Change the setting *before* you open the Calculator, or you will need to re-open the Calculator in order to enable the macros.

If you have Microsoft Office 2007, the process is a bit different. When you open the model you will see a “Security Warning” above the worksheet. Click on the warning, and then select “Enable Content” under the macro security notice. You may also see a warning about “links”. While you are free to enable links, it is not necessary, so you may leave this as-is. After enabling the macros, you will be able to use the Calculator.²

*****VERY IMPORTANT*****

If you are not using Microsoft Excel 2007, you MUST set security settings such that you can enable macros in the calculation tool. If you set your security level to “medium” prior to opening the model you will have the option of enabling macros in the file, otherwise if you leave your security settings at “high” you will not be able to enable macros at all.

CAUTION: If you set your security option to “low” then you will not be prompted to enable macros, they will simply be allowed and the model will run properly. However, if you select this security level be sure to upgrade the security level after you finish using this model, as it can make your computer vulnerable to excel files with executables that could contain viruses. We recommend selecting the “medium” security level so that you are prompted to enable macros on a file-by-file basis, *not the “low” security level*. This will ensure your computer is not at risk of being infected by unknown or unrecognized files.

² You must save the Calculator file when you are done as a “1997-2003 Excel” file, which is the format you received it in, or as a macro-enabled Excel 2007 (.xlsx) file in order for the file to function the next time you open it. You may get a warning of “loss of fidelity” if you save as a 1997-2003 file but you can select yes, as there is no loss of fidelity.

Honey Carbon Footprint Calculator User Guide

Chapter 3. Navigating through the calculator.

Beginning at the home page please answer each yes/no question by clicking on the downward arrow and selecting "yes" or "no" from the pull down menu. Completing these questions will instruct the model to make the appropriate worksheets available to you. When finished, click on "Next Page". Look for a "Next Page" button on each information input sheet to navigate to the final results page. Further instructions on how to navigate within each sheet are provided below.

At any time, you can navigate the model by selecting the worksheet tabs at the bottom of your Excel workbook. The "Next Page" buttons are meant only as a navigation aid.

*****VERY IMPORTANT*****

Each input sheet in this calculator contains both yellow and white cells. The yellow cells indicate that you must make a selection from several choices in a drop-down menu. To do so, please click your cursor inside the yellow cell. You will see a downward arrow appearing on the right side, which can be used to open a drop-down box with several options to choose from. Choose one of the options by clicking on it with your cursor.

The 'white' cells require numbers to be typed in. If you choose to leave a white cell blank, it will be treated the same in the calculations as if you had typed in a 'zero'.

CAUTION: if you type in a number in a white cell but did not select an option in the corresponding yellow cell, your number will be treated as a 'zero' as well.

Honey Carbon Footprint Calculator User Guide

Chapter 4. Beekeeping and honey production.

Inputs Needed.

The model for honey production can be found on the following sheets in the Excel file:

- Honey Production – User Input
- Honey production - Results

The input sheet consists of four different sections that require inputs from the beekeepers.

General.

General information includes name and address (optional) and annual honey production.

*****VERY IMPORTANT*****

In order to assess the carbon emissions of honey accurately, it is very important to indicate the share of your *beekeeping-related income* that comes from honey production, on an annual basis. Please note that this field is NOT referring to your total household or personal income, but only income directly generated from ALL of your beekeeping activities put together. The calculator will use this number to figure what portion of your operation's total greenhouse gas emissions is attributable to honey production rather than other beekeeping products or services. For example, if a part of your total annual beekeeping-related income results from pollination, a part of the greenhouse gas emissions in the life cycle of honey can be allocated to the party that uses the bees for pollination, instead of being allocated entirely to honey production.

Feeding.

The production of feed, such as sugar syrup, for honeybees involves the use of materials and energy that generate greenhouse gas emissions. This model contains the following feed options:

- Sugar syrup
- Pollen-substitute patties (no pollen)
- Honey
- Corn Syrup
- Sucrose (or sugar)
- Brewer's yeast

Under the heading **“Feed type (select feed type and indicate quantity)” (yellow cells)**, select the correct feed(s) from the ‘drop-down’ box. Insert the **amount used annually (white cells)** in the cell next to your feed selection.

Honey Carbon Footprint Calculator User Guide

Pest control: treatment for nosema and varroa.

As with feed materials, the production of pest control agents for treatment of nosema and varroa involves the use of energy and material inputs that lead to emissions of greenhouse gases. This model provides the following possible agents to treat nosema and varroa (in brackets, noting the active ingredient only):

- Vegetable grease
- Apiguard (thymol)
- Aplife (VAR thymol, eucalyptol, menthol, camphor)
- Apistan strips (fluvalinate)
- Apitol (cymiazole)
- Bayvarol (flumethrin)
- CheckMite+ (coumaphos)
- Formic acid, oxalic acid
- Lactic acid
- Fumidil (or Fumagilin)
- Mite-away II (formic acid)
- Others

Under the heading “**Treatment for nosema and varroa (select treatment type)**”, select the correct control material(s) from the ‘drop-down’ box (yellow cells). Insert the **quantities used annually** in the white cells right next to your selection.

Transportation.

Transportation is an integral part of the production cycle of honey. Transportation is required for the production of honey, for pollination (if applied) and to purchase necessary supplies for honey production and all other activities. The total greenhouse gas emissions related to transport depend on several parameters, such as total miles traveled, vehicle fuel efficiency (determined by truck type), and fuel type. The calculator requires inputting the following parameters that assess the impact of transportation:

- Type of truck
 - Single unit truck (gross weight between 8,500 and 14,000 lbs)
 - Combination truck (gross weight greater than 14,000 lbs)
- Fuel type
 - Diesel fuel
 - Gasoline

Honey Carbon Footprint Calculator User Guide

*****VERY IMPORTANT*****

The calculator provides three possible options to insert transportation data. If you keep records on total annual miles traveled, gas mileage and types of trucks used, please use that information. However, if you do not have all those details, but you DO keep records of total annual fuel use for tax and/or accounting purposes, you can enter only your fuel use information.

PLEASE NOTE: Before inserting either of these types of information, you MUST FIRST indicate which of the above two types of information you are using, under the heading “**What kind of information is available, please select?**”. Select the appropriate type of available information from the ‘drop-down’ box (yellow cell). The drop-down directs the calculator to bring you to one of the following sections of the sheet: total annual miles and MPG, total annual gallons fuel use per truck type, or total annual gallons fuel use.

PLEASE INCLUDE INFORMATION IN THIS SECTION FOR ANY HIRED TRUCKS YOU CONTRACTED OVER THE YEAR AS WELL, TO THE BEST OF YOUR ABILITY, OTHERWISE THE RESULTS WILL NOT BE ACCURATE.

Total annual miles and MPG (select fuel).

Under the heading “**Total annual miles and MPG (select fuel)**” select the appropriate activities (pollination, honey production and/or bee supplies and other activities) from the drop-down menu (yellow cell). Select the **right fuel type** for the truck, which will be a single unit truck (gross weight between 8,500 and 14,000 lbs), or combination truck (gross weight greater than 14,000 lbs) from the drop-down menu in cells B44, B45, B48, B49, B52 and/or B53.

Next, insert the total annual mileage for each truck (column C) and the gas mileage, in miles per gallon (MPG) (column D, white cell).

Total annual gallons fuel use per truck type (select fuel).

Under the heading “**Total annual gallons fuel use per truck type (select fuel)**” please select the appropriate fuel, diesel or gasoline, for the truck type(s) used from the drop-down in cell B51-B54 (yellow cells). Next, insert the annual fuel usage in cells C51-C54 (white cells)

Total annual gallons fuel use.

Under the heading “**Total annual gallons fuel use**”, type the annual amount consumed of diesel and/or gasoline (white cells).

Energy use during extraction.

The use of energy for the extraction of honey leads to emissions of greenhouse gases. This model contains the following possible activities that use energy:

- Bee removal and uncapping
- Extraction facility

Honey Carbon Footprint Calculator User Guide

The model contains the following energy sources for bee removal and uncapping and for the extraction facility:

- Gasoline
- Electricity
- Natural gas, in therms or cubic feet
- Propane

Under the heading “**Extraction, energy use (select energy source)**” select the appropriate energy source(s) for the bee removal and the extraction facility (yellow cells) and insert the **annual amount** used of each energy source(s) selected in the neighboring white cells.

Output.

After selecting and inserting the information about feeding, pest control, transportation, and honey extraction the model can assess the full burden of greenhouse gas emissions for honey production. Results are presented in the “Honey Production – Results” sheet. The model evaluates the following greenhouse gases: carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O). The carbon impact of these gases is summarized in CO₂-equivalents with 100-year Global Warming Potentials, based on the Intergovernmental Panel on Climate Changes 4th Report.

The output sheet shows the greenhouse gas emissions resulting from the different activities to produce honey: feeding, pest control, transportation, and extraction. The contribution of the three main greenhouse gases (carbon dioxide, methane and nitrous oxide) is presented as well as the total sum in CO₂-equivalents. The result sheet also shows a graph that presents the relative contribution of the main activities to the total greenhouse gas emissions of honey.

Honey Carbon Footprint Calculator User Guide

Chapter 5. Honey transport.

Inputs Needed.

The model for honey transportation calculates the greenhouse gas emissions of transporting the honey from the producers to the processors. This part of the model requires little input information.

Transport

The only data required in this part of the model is the average one-way distance in miles from the honey production location to the honey processor. Please fill in the average one-way distance (white cell).

Output.

After inserting the average one-way distance from the honey production site to the honey processor site the model assesses the total annual greenhouse gas emissions for the annual honey transportation. The model includes the following greenhouse gases: carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O), which are converted to CO₂-equivalents as in previous steps in the model.

Honey Carbon Footprint Calculator User Guide

Chapter 6. Honey packaging.

Inputs Needed.

The model for honey packaging can be found on the following sheets in the model:

- Packaging – User Input
- Packaging - Results

The input sheet consists of four different sections that require inputs from the honey packagers. Before entering the data that will be converted to greenhouse gas emissions some general information is requested.

General.

The input sheet asks honey packagers some general information, like names address and annual honey production. The spreadsheet model shows 'yellow' and 'white' cells. The 'yellow' cells indicate that a selection has to be made. When the user goes to the right site of a yellow cell, arrows appear, that can be used to open a drop-down menu with several options to choose from. The 'white' cells indicate that a number has to be filled in by the model user.

Honey packaging: indicate quantities for selected packaging types.

The input sheet for packaging materials consists of three different parts:

- A. Bottles and jars
- B. Re-usable drums and totes
- C. Other packaging material

A. Bottles and jars

The production for packaging materials, like glass, plastic or steel is related to the use of materials and energy that involve emissions of greenhouse gases. This model contains the following type of packaging materials:

- Bear, different sizes
- Honeycomb, both from glass and plastic, in different sizes
- Hexagonal, glass, 8oz
- Jar, glass, 56oz
- Jug, plastic, 1lb and 5lb
- Pail, 1 and 5 gallon

Since several other packaging types are available, the model also contains options to select a typical size of packaging in combination with the material type, glass or plastic.

The plastic packagings have the options to select a no-drip lid.

Under the heading "**A. Bottles and jars**" fill in the total number of containers used in one year by container type (white cells). If a no-drip lid is used for plastic packagings,

Honey Carbon Footprint Calculator User Guide

please indicate this in the yellow cell (drop-down menu with yes/no), right next the cells with the annual container use numbers.

B. Re-usable drums or totes

Honey packagers that pack the honey in re-useable packaging can insert their information in this part of the model. Information about the following re-usable packaging can be inserted:

- 55-gallon steel drum
- 275-gallon plastic tote
- 275-gallon paper tote.

The number of annual used drums and/or totes can be inserted in the white cells.

C. Other packaging materials

Information about other materials that are used to pack the honey can be filled in in this part of the model. The model contains the following other packaging materials:

- Shrink wrap
- Cardboard

The amount used annually (in lbs) of these materials can be inserted in the white cells.

Other materials used.

Honey processors and packagers that use other materials, gloves, and filter sheets can indicate the quantities used annually in this part of the model. The model contains the following materials:

- Rubber gloves
- Latex gloves
- Plastic gloves
- Filter paper sheets

The annual usage amount (in pairs for the gloves and in lbs for the filter paper sheets) of these other materials can be inserted in the white cells.

Annual energy use: honey packing

The use of energy for packing honey leads to emissions of greenhouse gases. The model contains the following energy sources for bee removal and uncapping and for the extraction facility:

- Electricity
- Natural gas, in therms or cubic feet

Under the heading **“Annual energy use, honey packing (please select energy source)”** select the right energy source(s) (yellow cells) and insert the **amount consumed**

Honey Carbon Footprint Calculator User Guide

annually of the(se) energy source(s) in the cell neighboring the type of energy source is selected (white cell).

Output.

After selecting and inserting the information about packaging material uses, other material uses and energy use for honey packing the “Packaging – Results” sheet shows the total annual greenhouse gas emissions for the annual honey production. The model includes the following greenhouse gases: carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O), summarized in CO₂-equivalents

The result sheet also shows a graph that presents the relative contribution of the main activities to the total greenhouse gas emissions of packing honey.

Honey Carbon Footprint Calculator User Guide

Chapter 7. Total results.

If you are a producer and packer, then your final sheet of the model will be “Total results”. This page summarizes and aggregates the results of the three previous parts of the model, and lets you link to the detailed results page for each process:

- Honey production;
- Honey transport, and
- Honey packaging.

This sheet will not appear if you are a producer who does not pack your own honey or if you are a processor/packer only. In these cases you will see the following:

- If you are a producer who did not fill out the “Transport. – Input & results” worksheet, then your final page is “Honey Production – Results”.
- If you are a producer who did fill out the “Transport. – Input & results” worksheet, will have a final page that summarizes results entitled “Producer Results.” For one kg of honey this sheet shows the quantity of greenhouse gases emitted to produce the honey, and to transport it to the packing facility. This is in addition to the summary of results from your production activities available in the “Honey Production – Results” worksheet.
- If you are a packer only, then your summary of results will be shown at two levels. The detailed packing facility carbon footprint will be shown in the “Packaging – Results” worksheet. The summary results show you the transportation carbon footprint (from producers to your facility) and the carbon footprint from your facility’s operation.