



Tool Documentation

INDUSTRIAL DECARBONIZATION TOOLKIT

USER GUIDE FOR FACILITY CO₂e FLOW TOOL

Table of Contents

Introduction	2
How to Use the Tool	3
FCFT – Input Sheet	3
Inputs	3
Outputs	5
FCFT – Visualization Application	6
Inputs	6
Output	9

Introduction

The [Facility CO₂e Flow Tool \(FCFT\)](#) quantifies and visualizes a facility's CO₂e emissions using a Sankey Diagram (Figure 1). With an interactive Sankey Network Diagram, it enables users to gain insights into patterns, trends, hotspots, and distributions of CO₂e emissions at a facility. Using this visualization, the decarb assessment team can identify high emitting sources and prioritize them during their assessments. The tool helps breakdown the total facility emissions into subcategories of energy, process and fugitive emissions, which can be broken down further into individual equipment/process for a component level analysis (Figure 1).

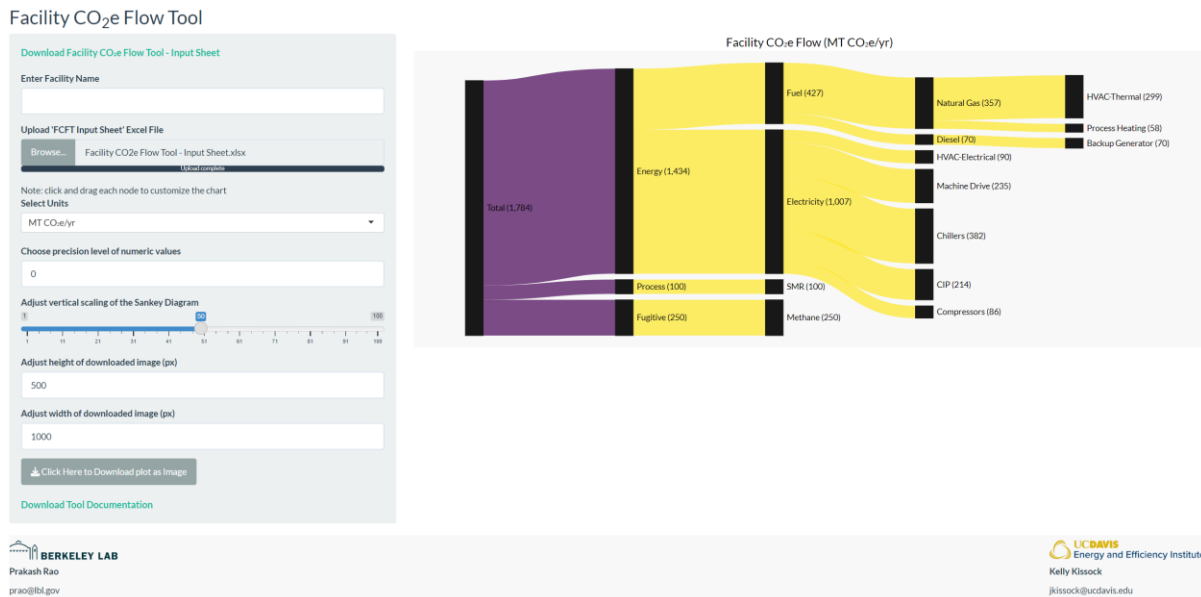


Figure 1: Facility CO₂e flow for a representative facility (MT CO₂e/yr)

The tool is designed to determine baseline emissions but can be employed to run different scenario analysis based on user inputs. One such scenario analysis with this tool can be employed to compare a facility's baseline emissions with emissions post-implementation of decarbonization measures. Moreover, future years can be modelled by varying the "year of analysis" input, which can help give a snapshot into the future emissions of a facility under varying grid emissions intensities.

This guide outlines the tool's working principles and provides step-by-step guidelines on how to use the tool.

How to Use the Tool

The tool is split into two components:

1. Input Sheet (Excel-based)
2. Visualization Application (Web-based)

The Input Sheet takes data on the facility’s end-uses and energy consumption to compute the emissions, whereas the Visualization Application converts this quantitative data into a Sankey Diagram. This section outlines how to navigate and use each of the two components.

FCFT – Input Sheet

Inputs

Types of Input: The inputs cells are color-coded using a ‘light-yellow’ shade (see below).

Input Cells

1. Select Electricity Emissions Factor

Electricity emissions factor is used to calculate emissions related to electricity consumption at a facility. The tool provides two options to select this emission factor, as described below:

a. Option A – Enter Custom/Market-based Emissions Factor

This option allows users to enter custom/market-based emissions factor for electricity, where available for the calculations. This value can be supplied through the local utility company, or it can be a company’s own value based on internal calculation. This value must be entered in the units of ‘MT of CO₂e/kWh’.

b. Option B – Use Grid Emission Factor

This option uses the available emission factor for the selected state & year and applies that to the emissions calculation associated with electricity.

i. Select State and year of analysis

STATE (select from dropdown)	YEAR (select from dropdown)
CA	2021 (Current eGRID)

This input determines the grid emissions factor to be used in the emissions’ calculations. Current emissions rate is based on [eGrid Database¹](https://www.epa.gov/system/files/documents/2023-01/eGRID2021_summary_tables.pdf), whereas future forecasts are based on average emissions rate from NREL Cambium Database, using

¹ https://www.epa.gov/system/files/documents/2023-01/eGRID2021_summary_tables.pdf

the mid-case with tax-credit phase-out scenario. More on NREL Scenarios can be found at [Cambium 2022 Scenario Descriptions and Documentation²](https://www.nrel.gov/docs/fy23osti/84916.pdf).

ii. Specify Clean Electricity Share

Clean Electricity Share (For facilities with onsite renewables or Clean Power Procurement)	0%
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Clean electricity share is the percentage of electricity used at the facility that was supplied using zero CO₂e sources. Onsite renewables, Renewable Energy Certificates (RECs) and Power Purchase Agreements (PPAs) are some of the sources that can contribute to the clean electricity share.

This percentage adjusts the emissions factor extracted from the Grid Database by the ratio as specified, so that the emissions factor is accurately representative for the facility’s perspective.

This share may be determined by the following equation:

$$\begin{aligned}
 \text{Clean Electricity Share}(\%) & \\
 &= \frac{\text{Annual electricity supplied by clean sources}}{\text{Annual total electricity consumed by the plant}} \times 100\%
 \end{aligned}$$

2. Complete Energy Use Breakdown Table

Emission Source	Emission Category	Energy Source	Units	Annual Consumption	CO ₂ e Emissions - Process/Fugitive (MT CO ₂ e/yr)
		(Use only if Emission Category is Energy)	(Use only if Emission Category is Energy)	(Use only if Emission Category is Energy)	(Use only if Emission Category is Process or Fugitive)
Boiler	Energy	Natural Gas	MMBtu	2,000	

This tables serves as the main input array for the emissions calculations. Please follow the following steps to fill this table:

- **Emission Source:** Specify the name of the end use equipment/process which is a source of emissions at the plant site. Examples may include boilers, process heating, process cooling, pumps, compressors, and HVAC system, among others.
- **Emission Category:** Select which category from energy, process or fugitive do the emissions belong to.
- **Inputs for ‘Energy’ Emissions Category**
 - **Energy Source:** Enter the energy source the end use operates on. Examples may include coal for a boiler, electricity for pumps, natural gas for process heating and so on. In addition to the pre-loaded energy sources, more can

² <https://www.nrel.gov/docs/fy23osti/84916.pdf>

be added in the 'Energy Sources' table (see below) in the 'Emissions Factor' sheet.

Emission Factors for Energy Sources					
Energy Source	CO ₂ Intensity (MT CO ₂ /)				
	KJ	kWh	MMBtu	GJ	therms
Electricity	6.1E-08	2.2E-04	6.4E-02	6.1E-02	6.4E-03
Natural Gas	5.0E-08	1.8E-04	5.3E-02	5.0E-02	5.3E-03
Propane	6.0E-08	2.1E-04	6.3E-02	6.0E-02	6.3E-03
Petroleum Coke	9.7E-08	3.5E-04	1.0E-01	9.7E-02	1.0E-02
Distillate or Light Fuel Oil	7.0E-08	2.5E-04	7.4E-02	7.0E-02	7.4E-03
Coal	9.1E-08	3.3E-04	9.6E-02	9.1E-02	9.6E-03
Diesel	7.0E-08	2.5E-04	7.4E-02	7.0E-02	7.4E-03
Motor Gasoline	6.7E-08	2.4E-04	7.1E-02	6.7E-02	7.1E-03

Source: https://www.eia.gov/environment/emissions/co2_vol_mass.php

- **Units:** Select units for the selected energy source.
 - **Annual Consumption:** Enter the annual consumption of the fuel for the specific end use in the units selected previously.
 - **CO₂e Emissions - Process or Fugitive:** Enter the quantity of emissions coming from these emission categories.
3. **Save and Close file.**

Outputs

The excel workbook's outputs are depicted using the cell color as shown below, please do not make changes to these output cells.

Output Cells

1. **CO₂e Emissions - Energy**

This is the calculate emissions for each end-use specified under the 'energy' emissions category in MT CO₂e per year.

2. **CO₂e Emissions**

This output combines all emissions from all categories in MT CO₂e per year.

3. **Percentage of Total Emissions**

This output identifies the proportion of emission from the specific end use in terms of the total emissions.

FCFT – Visualization Application

The visualization component of the tool is hosted online and can be accessed [here](#). The user interface for the visualization application is shown in Figure 2.

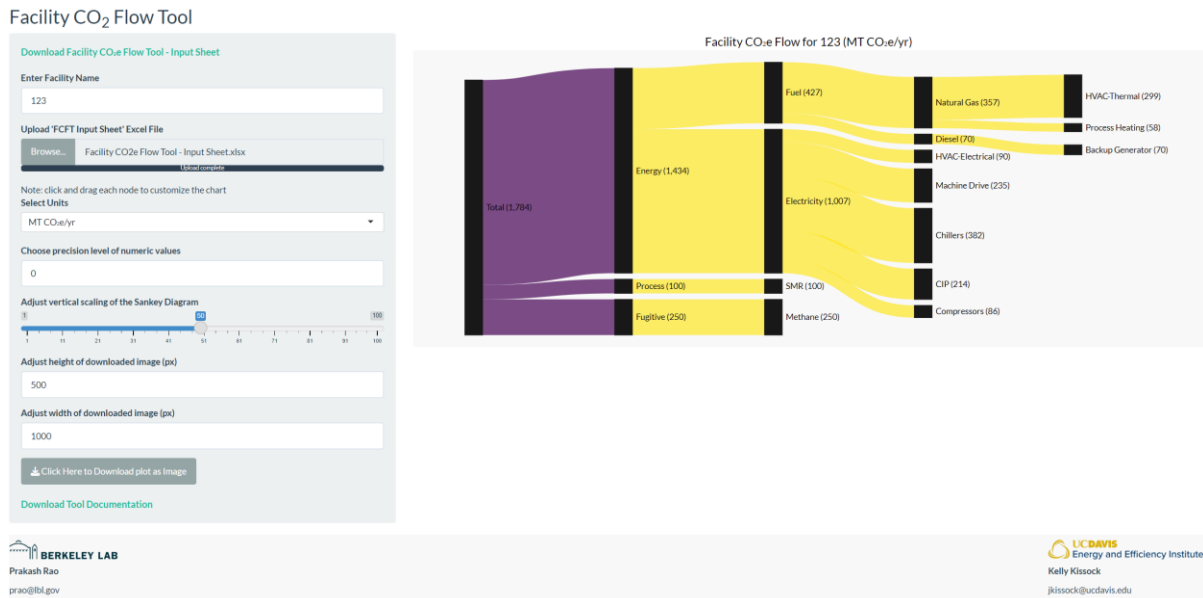


Figure 2: FCFT Web Tool – User Interface

Inputs

1. Enter Facility Name

Enter Facility Name

In the sidebar panel on the left, enter the name of your facility in the "Enter Facility Name" text box. This input is used to formulate the caption for the Facility CO₂e Flow Diagram.

2. Upload 'FCFT – Input Sheet' Excel file

Upload 'FCFT Input Sheet' Excel File

Browse...
Facility CO₂e Flow Tool - Input Sheet.xlsx

Upload complete

Click the "Browse" button next to the "Upload FCFT Input Sheet Excel File" label to upload the filled out 'FCFT Input Sheet Sheet' to the web tool.

3. Adjust the bars of the Facility CO₂e Flow Diagram (optional)

Click and drag each node to customize and adjust the chart visually.

4. Select Units (optional)

Select Units

MT CO₂e/yr

Select the appropriate units from the "Select Units" drop-down menu. The available options are "MT CO₂e/yr." and "lbs. of CO₂e/yr."

5. Select Precision Level of numeric values (optional)

Choose precision level of numeric values

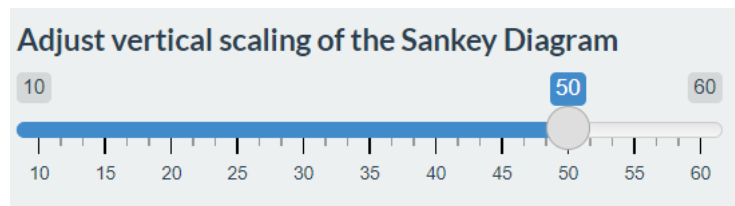
0

Choose the level of precision for the Facility CO₂e Flow Diagram by adjusting the numeric input "Choose precision level of numeric values". This precision level is used to determine how the emissions values are rounded off. Increasing this number increases the precision of the emission values and vice versa.

6. Adjust Vertical Scaling of the Facility CO₂e Flow Diagram (optional)

Adjust vertical scaling of the Sankey Diagram

10 50 60



Depending on the number of end-uses entered, the vertical scaling of the diagram might need adjustment. This slider input can be used to alter the vertical scaling of the diagram.

7. Download Facility CO₂e Flow Diagram



The screenshot shows a light gray rectangular panel with two input fields and a button. The first input field is labeled "Adjust height of downloaded image (px)" and contains the number "500". The second input field is labeled "Adjust width of downloaded image (px)" and contains the number "1000". Below these fields is a dark gray button with a white download icon and the text "Click Here to Download as Image".

To download the Facility CO₂e Flow Diagram as an image, click the "Click Here to Download as Image" button. You can adjust the size of the downloaded image by adjusting the inputs for height and width in pixels.

Output

The output from the online tool is a Facility CO₂e Flow Diagram showing the facility's emissions broken down into its energy sources and end-uses (Figure 3).

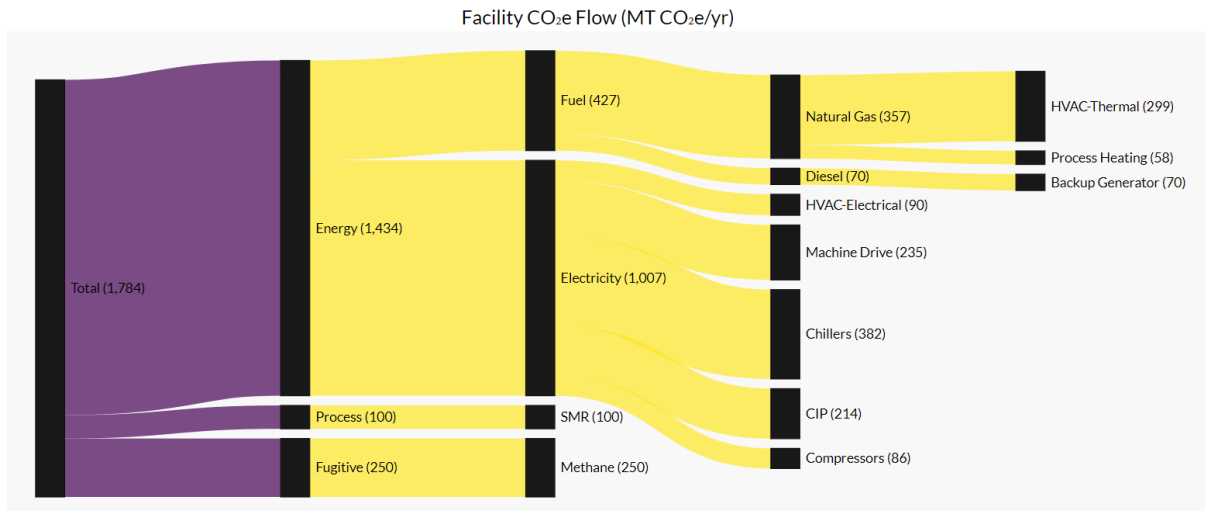


Figure 3: Facility CO₂e Flow Diagram (tool output)