**Bonsucro Sugarcane Pathway: creating a collective pathway for GHG mitigation by establishing science-based targets in the sugarcane sector**

**DRAFT TARGET-SETTING GUIDE**

Context

Once you have established a baseline of your company’s corporate carbon footprint with the Bonsucro Calculator or other carbon accounting scheme, you can utilize the “Sugarcane Target-setting Tool” to establish a goal for reducing emissions, specifically from the production of sugarcane.

The reduction pathway and goals generated by the tool will allow your organization to establish a reputable climate change goal. Alternatively, the tool is available with default values for users who have not completed a GHG inventory using the Bonsucro Calculator or other carbon accounting scheme.

What is the science-based target initiative?

The Science Based Target Initiative (SBTi) is a leading initiative that provides a technical framework and guidance for companies to reduce their greenhouse gas (GHG) emissions, helping prevent the worst impacts of climate change and future-proof business growth. Targets are considered ‘science-based’ if they are in line with what the latest climate science deems necessary to meet the goals of the Paris Agreement – limiting global warming to well below 2°C above pre-industrial levels and pursuing efforts to limit warming to 1.5°C. A science-based target is a paradigm shift for most companies. The goal is not about how much GHG emissions reduction you think you can achieve but how much you need to achieve to prevent the worst effects of climate change.

SBTi was launched in 2015 by the Carbon Disclosure Project (CDP), the UN Global Compact, the World Resources Institute (WRI), and the World Wildlife Fund (WWF) and is generally considered a robust standard for establishing corporate climate targets. As of May 2023, there were over 5,000 companies taking action with the initiative, which typically involves five key steps:



SBTi standards and criteria for developing targets are freely available to the public, however in order to have a target officially validated by SBTi as “science-based” the criteria and process must be followed closely, and a fee is required for an official review.

This guide reviews the SBTi standards at a high level and principally focuses on Bonsucro’s unique tool for setting sugarcane reduction targets aligned with SBTi.

If your organization requires official validation, we strongly encourage you to review the latest standards on the [SBTi website](https://sciencebasedtargets.org/).

1. Requirements for setting science-based targets

For official validation, at minimum, companies that buy or supply sugarcane are required to set three separate science-based targets to reduce emissions, including;

* **Scope 1 & 2.** Scope 1 and 2 emissions reduction target that addresses emissions from activities like natural gas and electricity use in owned manufacturing facilities.
* **Scope 3.** A scope 3 reduction target that addresses emissions from activities like product transport, waste, and indirect emissions from commuting or business travel. This goal can be combined with scope 1 and 2 in an overall target but is often separate.
* **FLAG\*.** Finally, a target that explicitly addresses emissions that come from forest, land, and agricultural activities is required.

\*The sugarcane pathway tool focuses only on developing a target specifically for FLAG emissions.

For all of these targets, it’s important to measure and establish a baseline year of emissions first, as this will be the primary input for any target development.

It’s also important to determine the amount of emissions to include in the targets and establish a target year in line with the SBTi requirements. At a high level, these requirements include:

* **A base year.** Your base year of emissions cannot be any earlier than 2015 and is encouraged to be the same across all scopes, including FLAG. It’s recommended to use data from your most recent inventory of emissions as a base year.
* **Target year.** Companies have the option to set only “near-term targets,” which must be 5 - 10 years from the year the goals are submitted, as well as “long-term targets” that achieve reductions by 2050.
* **Emissions included.** There are different requirements for near-term and long-term targets in terms of the amount of emissions that need to be addressed in the goals. These requirements also vary by scope. For FLAG targets in the near term, only 67% of emissions need to be addressed in the target, however, in the long term 90% of emissions need to be included. However, these are just the minimum thresholds, and a company can choose any percentage of emissions above the minimum.
1. Why FLAG emissions?

Globally emissions that come from Agriculture, Forestry, and Other Land Use (AFOLU) comprise 22% of global GHG emissions, of which half (50%) comes from land use change and land management emissions. Additionally, the carbon removal and storage potential in agriculture from soil carbon sequestration and biomass carbon accumulation (e.g., agroforestry) represent a critical opportunity to support the goal of limiting warming to a 1.5°C threshold.

Recognizing this challenge and opportunity, SBTi now specifically requires companies in the food and beverage industry or companies whose emissions from the forest, land, and agriculture (FLAG) are greater than 20% set goals for reducing these FLAG emissions.

Measuring FLAG emissions

In order to assess the emissions and to develop a target, FLAG emissions often need to be removed from the other scope 1, 2, and scope 3 categories and further refined.

To start, it is helpful to understand the FLAG emissions boundary. FLAG emissions occur from cradle to farm gate, which essentially means any activity that happens on farm, as well as upstream activities, are categorized as FLAG.

For sugarcane, although milling needs to happen quickly after sugarcane harvest, requiring immediate transport, this transportation is considered “beyond the farm gate”. It thus should not be included in the total FLAG emissions for sugarcane.

If your entity owns the farm, buildings, and equipment, FLAG emissions may actually be scope 1 and 2 emissions, however, for many traders or brands where sugarcane production is within the supply chain, FLAG emissions are embedded within scope 3 emissions.

According to the accounting frameworks established by SBTi, the FLAG emissions associated with farm-level sugarcane production need to be split into two major categories. Emissions that come from the conversion of land need to be accounted as **land use change (LUC)** emissions, while all other emissions, such as those that come from on-farm energy use for machinery or the application of fertilizers, are categorized as **land management emissions (or non-LUC).** As agricultural commodities, including sugarcane, also have the potential to sequester carbon in soil or through the use of new technologies such as biochar, the SBTi included the ability to account for **carbon removals** in the original FLAG target-setting exercise.

The following table highlights the data required for the baseline assessment year and typical sources of emissions for sugarcane that may be classified as LUC or Non-LUC, as well as removals.

*Table 1. Example of Sugarcane FLAG emissions & removals*

|  |  |  |
| --- | --- | --- |
| **Section** | **Data Point** | **Documentation/Data requirement** |
| Land Management (Non-LUC) | EF value (t CO2eq) per t sugarcane fresh weightOr Total Emissions (t CO2eq) and Total purchased volume (t fresh weight) | Full cradle to farm gate inventory of emissions sources including:* emissions from production & transportation of farm inputs (fertilizers, pesticides, fuels, electricity)
* emissions from fuel & energy use on farm for application of inputs (fertilizers, pesticides, irrigation) and agricultural practices (tillage, harvest, etc.)
* emissions directly from soil (breakdown of N by bacteria or C from lime)
* emissions from the burning of sugarcane
 |
| Land Use Change (LUC) | Emissions from LUC (t CO2 eq) per t sugarcane fresh weightOr Total LUC Emissions(t CO2eq) and Total purchased volume (t fresh weight) | Direct emissions from the conversion of one land cover type to another (calculated as carbon stock change) |
| Removal  | Removals (t CO2eq) per t sugarcane fresh weightOrTotal Removals(t CO2eq) and Total purchased volume (t fresh weight) | Carbon sequestration may come in the form of increased removals in soil organic carbon (SOC) or through the application of biochar |

Accounting for FLAG emissions generally follows the same approach as the Bonsucro Calculator as outlined by the GHG Protocol, however there are specific requirements within the forthcoming [GHG Protocol Land Sector and Removals Guidance (GHG LSRG)](https://ghgprotocol.org/land-sector-and-removals-guidance#supporting-documents) that apply specifically to FLAG emissions and potential removals.

At this time, due to the accounting and validation requirements by the [GHG LSRG](https://ghgprotocol.org/land-sector-and-removals-guidance#supporting-documents), the Bonsucro Calculator does not yet have the capability to credibly report on removals.

For companies who do not have a carbon inventory in place and no primary data, default GHG emissions values are provided in the Target-setting Tool for use in select geographies.

# Pathway Methods and Science

# Pathway Context

The sugarcane pathway’s Target-setting Tool allows users to enter their base year FLAG emissions and provides a clearly defined pathway for the required emission reductions in the 27 IMAGE regions provided by the tool.

Broadly SBTi utilizes two methods for calculating required reductions in agricultural contexts:

1. **Sector Pathway.**  This pathway requires an absolute reduction of emissions regardless of growth and follows a 3.03% linear annual reduction path. This pathway is recommended for “demand side actors,” such as consumer packaging goods companies or companies whose FLAG emissions are within scope 3. A sector target-setting tool is available on [SBTi’s website](https://sciencebasedtargets.org/sectors/forest-land-and-agriculture).
2. **Commodity-Specific Pathway.** The commodity pathway models are specific to certain agricultural commodities. In these pathways, the annual reduction rate is applied relative to the amount of emissions and considering intended growth in volume, which is known as the intensity approach. These pathways are recommended for “supply-side actors” whose main activity is agriculture or forestry production, or FLAG emissions are within scope 1. Specific pathways exist for beef, pork, chicken, dairy, leather, wheat, maize, rice, palm oil, soy, and timber & wood fiber across 26 regions.

Currently, the commodity pathways are not required by SBTi, except for the timber industry; however, the commodity and geography lens are helpful for additional communication and internal progress tracking purposes.

The sugarcane pathway tool was designed similarly to other SBTi FLAG commodity pathways (wheat, soy, dairy, etc.) in the sense that it is an intensity-based tool focused on sugarcane only and includes geographically specific representation, as explained in the following sections. Although it’s important to set goals across the value chain and scopes of emissions, please note that the tool does not cover the emissions of further transporting and processing sugarcane beyond the farm.

The integration of the sugarcane commodity pathway as aligned with the FLAG tool is based on the creation or adaptation of five datasets:

1. Production forecasts of sugarcane from 2015 to 2050,
2. Regionalized yields of sugarcane production,
3. Land management emissions from sugarcane production,
4. Land-use change emissions allocated to sugarcane and
5. A target value for removals allocated to on-farm sugarcane production.

**Production Forecasts**

To complete the intensity-based calculation, the expected production increase for a company must be compared to global averages of production. FAO data was utilized to aggregate the annual production in each IMAGE region from the years 2005 to 2021 (FAOstat 2022). Sugarcane production volumes were forecast utilizing the OECD Agricultural Outlook for years 2022-2031 and projected to 2050 using the IMAGE SSP2-26 scenario for the production of energy crops (OECD 2022, Riahi et al. 2017). These data represented global values (OECD and IMAGE) and were disaggregated by region by calculating the FAO production fraction from each IMAGE region averaged across the years 2019 to 2021.

**Land Management Emissions**

The sugarcane commodity pathways include default land management emissions derived from the use of the Bonsucro Calculator or from World Food Life Cycle Database (WFLDB), when data is unavailable from primary data collection. Table 2 summarizes the main impact drivers captured in the FLAG calculation for sugarcane land management emissions.

*Table 2. Example of Sugarcane FLAG emissions*

|  |
| --- |
|  Fertilizer (NPK) emissions, as well as transport and production of fertilizer |
|  Lime emissions, as well as transport and production  |
|  Herbicide and pesticide use, as well as transport and production  |
|  Energy use of buildings and machinery (Ex. gasoline, diesel, natural gas, electricity)  |
|  Aircraft fuel  |
|  Emissions from sugarcane burning |
|  Emissions from crop residues left in fields |
|  Emissions from filter cake |
|  Emissions from vinasse |
|  Emissions from energy used in irrigation |
|  Ripener & Other crop chemicals, as well as transport and production  |

The emissions intensity pathway was projected assuming that the intensity of sugarcane will evolve at a similar rate as the row crop commodities (wheat, soy, maize, rice), as calculated in the original IMAGE model.

**Land Use Change Emissions, Yields & Removals**

The default land use change impacts are calculated for each region following the methodology outlined in the [SBTi FLAG Guidance](https://sciencebasedtargets.org/resources/files/SBTiFLAGGuidance.pdf) and [SBTi FLAG Methods Addendum](https://sciencebasedtargets.org/resources/files/SBTiFLAGMethodsAddendum.pdf). Statistical land use change is calculated using the historical expansion method for the default values in the pathway tool. The impact of LUC is calculated for an average unit of land in each geography and allocated to a unit of fresh weight of sugarcane-based on the relative yield for each region. Yield values are determined from FAO and aggregated for each IMAGE region where necessary. Land use change emissions may also be entered using primary data or from values derived from the Bonsucro Calculator.

The LUC pathway is calculated following the [SBTi FLAG Guidance](https://sciencebasedtargets.org/resources/files/SBTiFLAGGuidance.pdf), with emissions following the deforestation pathway. The deforestation pathway begins at the baseline year of 2015 and achieves a linear decrease of 25% in 2020 and then a further 100% decrease in deforestation by 2030. The emissions calculation includes a 20-year equal allocation of deforestation emissions impact through 2050.

Removal intensities for each region are similarly calculated following the methods outlined in the [SBTi FLAG Guidance](https://sciencebasedtargets.org/resources/files/SBTiFLAGGuidance.pdf) and allocated to production units based on geographically specific yield values. Removals target values are derived from Roe et al. 2019 and follow a yearly linear pattern from 2020 to 2050, encapsulating a total of 32 Gt of CO2 eq removals across all global agricultural production.

As these methods closely follow the original methodology outlined in the [SBTi FLAG Guidance](https://sciencebasedtargets.org/resources/files/SBTiFLAGGuidance.pdf), they are intended to be compatible with the results generated by the [SBTi FLAG tool](https://sciencebasedtargets.org/resources/files/SBTiFLAGTool.xlsx). For any further information on key assumptions and limitations, please reference the [SBTi’s FLAG Methods Addendum](https://sciencebasedtargets.org/resources/files/SBTiFLAGMethodsAddendum.pdf).

# 4. Instructions for using the Pathway Target-setting tool

The typical user of the Bonsucro sugarcane emissions pathway tool will mainly interface with the first two tabs in the Excel spreadsheet, titled “Intro” and “Calculations.” The “Intro” tab is a summary tab with information on the tool developers, version number, and a brief summary of the other tabs in the sheet. The “Calculations” tab is where the user will enter the information required by the tool to calculate an emissions pathway. The “Calculations” tab is arranged into two sections, titled “Inputs” and “Results,” and instructions for entering data and interpreting the results are summarized below.

**Inputs Needed**

The pathways tool requires data relating to the three main pathways (Land Management, LUC, and Removals) as well as some demographic data on geography, production volumes, and assessment years. The tool also presents the option for users with information on multiple regions to generate multiple pathways on separate rows. The following steps for data entry are listed based on the column headers in the calculation tab:



**Step 1- Commodity & Region:** The commodity listed here is sugarcane and will not need any adjustment. The region may be chosen based on the region that best matches the geography where the sugarcane is sourced from. More information on the 26 regions + world average can be found by following this [link](https://models.pbl.nl/image/index.php/Region_classification_map).

**Step 2- Base Year (BY) & Target Year (TY):** The base and target years can be selected based on criteria outlined in the section titled *Requirements for setting science-based targets*. A base year must be selected to be consistent with other FLAG targets previously set by a company. The target year may be determined by the decision to set a near term (5-10 years) or long-term (TY = 2050) target.

**Step 3- Production BY & Production TY:** These values are the total amount of sugarcane in t of fresh weight sourced from a given region in the selected baseline year or target year. The baseline data may be found in a corporate footprint or may be derived from the output summary tab of the Bonsucro calculator.  The target year data may be determined by long-term sourcing or growth targets forecasted by the company.

If volumes of sugarcane derived co-products (eg, raw or refined cane sugar, molasses or ethanol) are sourced in place of sugarcane, it is important to convert these volumes to match their raw cane volume needed for the tool. As milling and refinery processes for each individual product may vary across geographies, users of the tool may look to suppliers to provide raw cane equivalencies for individual products. With these values in hand a user can convert their volumes using the following equation.

$$Raw sugarcane volume (kg) =Sugarcane derivative volume sourced (kg or l) \* \frac{x kg Sugarcane }{1 (kg or l) sugarcane derivative}$$

According to the USDA, a tonne of sugarcane may yield 10-15% in raw sugar by weight, and roughly 80 liters of ethanol (Shapouri & Salassi, 2006).

**Step 4- Land Management Emissions, LUC Emissions & Removals Intensity:** The data points and scope for these three rows are captured in Figure 1 below. If total emissions are known, these can be entered directly into the cells corresponding to the correct geography. If only emissions intensities per tonne of sugar cane are known for a given region, these values may be multiplied by the total sourced cane to determine the total emissions for each category. Data for Land Management and LUC emissions per tonne of cane are provided in cells C211 and C217, respectively, in the P3 Agric Tab of the Bonsucro Calculator (V5.1.4). If not using emissions data from the Bonsucro Calculator, it is important to check if the emissions data used includes LUC as required by SBTi. Also, a key step is to disaggregate any emissions data based on the amounts from LUC and Land Management. However, if any of this information is unknown, the cells may be left blank, and default values will be used.

**Step 5- Total Emissions:** This is the sum of the baseline emissions from Land Management Emissions, LUC Emissions & Removals Intensity.

**Interpreting Results**

With this information entered into the correct columns, the tool will generate results for the emissions intensities in the given target year for each region under study. The results of the calculation are given in the form of Emissions Intensities broken out into Land Management, LUC, and Removals, as well as Net Emissions with and Without Removals included.

Figure 1 – Data points and scope



These results represent the target year emissions intensities needed to set a FLAG target.