Web app: Calculation of Paris-compatible national CO2 budgets and emission targets

- Global Carbon Project database (national emissions including LUC) -

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Content

Distribution of a global CO2 budget

The app is based on the **distribution** of a **global CO2 budget** using a **weighted distribution key** that takes into account the share of the global population and the share of global emissions of the selected country in a base year (*BY*). This makes it possible to map the two most important factors "**climate justice**" and "**current reality**":

$$B^i = \left(C * \frac{P^i_{BY}}{P_{BY}} + (1 - C) * \frac{E^i_{BY}}{E_{BY}} \right) * B$$

where

$E_{BY}\ or\ E^i_{BY}$	global emissions or emissions of country *i* in the base year; here: *BY* = 2019
$P_{BY}\ or\ P^i_{BY}$	global population or population of country *i* in the base year; here: *BY* = 2019
$B\ or\ B^i$	global CO2 budget or national CO2 budget of the country *i*; here: from and including 2020
C	weighting of the population

In the web app, the year **2019** is used as the **base year** for calculating the weighted **distribution key**. You can predefine the weighting of the population (*C*).

On the general question of allocation keys for a global budget, see the corresponding excursus in: (Sargl, et al., 2025b).

Global framework data that lead to realisable national targets

One aim of this web app is to identify generalisable global framework data leading to achievable targets regarding territorial CO2 emissions.

The challenge here is to find a combination that is compatible with the Paris climate targets (global CO2 budget), takes sufficient account of climate justice (weighting population), does not mean an uncovered check in the future in the case of net negative emissions (see Chapter "Overshoot") and at the same time leads to realisable national targets, at least for the major emitters. As the results of the web app show, there is a trade-off between compliance with the Paris climate targets and climate justice. We must face up to this difficult question.

Databases used

Global Carbon Project (GCP) provides the total relevant CO2 emissions for all countries worldwide, which are to be offset against the CO2 budgets according to the IPCC (GCP, 2025). The only emissions missing are those from international shipping and aviation (ISA).[1]

GCP uses three different sources for CO2 emissions from land-use change (LUC), which can produce very different results. As GCP does at the global level, this tool uses the average value of the three sources. It should be emphasised that there is generally a high degree of data uncertainty when it comes to LUC. We therefore also refer to our tools, which reserve a LUC budget at global level (see Chapter "Further tools").

The population figures are taken from the EDGAR database and are based on the per capita emissions specified there (EDGAR, 2025).

[1] Cement Carbonation Sink (CeCS) is not taken into account here. Since GCP takes CeCS into account in global CO2 emissions, these are shown for information purposes in the actual emissions in the tool. It seems debatable whether CeCS should be taken into account in the emissions that are to be offset against the remaining CO2 budgets according to the IPCC. If this were the case, slightly higher national budgets would result.

Determination of the global CO2 budget to be distributed from and including 2020 onwards

Here we have summarised important statements of the IPCC on remaining global CO2 budgets from 2020 on (IPCC, 2021). The following is a condensed rendition:

Warming	Remaining carbon budgets		
Probabilities:	*50%*	*67%*	***83%***
[°C]	[GtCO2 from and including 2020 on]		
1.5	500	400	**300**
1.6	650	550	**400**
1.7	850	700	**550**
1.8	1000	850	**650**

Global CO2 budget for ISA emissions has to be subtracted from the global remaining CO2 budget when using the GCP database, as the country data do not include these emissions (see above).

Selection of the country

In the selection field for the country, you will be offered the six largest emitters in descending order. There you can also select global emissions (the sum of the national emissions considered here) or total global emissions (including ISA). After that, the remaining countries are offered to you in alphabetical order.

National CO2 budget

The resulting national budget from and including 2020 on is shown. In addition, the remaining budget is given taking into account already published emissions after 2019, which are also shown further below.

Linear emission paths[2]

For the **emission targets**, the web app assumes a linear emission path.

Two emission paths are calculated:

(1) Start year 2020 (red dotted emission path in the graph).
(2) Start year taking into account already published actual emissions after 2019. The start year is indicated.

Both paths are based on the calculated budget from and including 2020 on.

The **year of emissions neutrality**[3] for the second pathway is marked in red in the main sheet if it is smaller than in the first pathway. This means that the selected country is not on the track under the chosen framework conditions. Otherwise, the year is marked in green.

[2] For the formulas used here to calculate linear emission paths, taking into account possible net negative emissions, see: (Wittmann & Wolfsteiner, 2023, GLPM).

[3] Notes on the year of emissions neutrality:

1. Definition: The year of emissions neutrality is the first year in which the total emissions of a year are negative or in which the total emissions of a year are zero.
2. Rounding rules: At the bottom of the sheet, you will find the point of emissions neutrality. If the potential for net negative emissions is zero, this value is always rounded up. Otherwise, this value is rounded.
3. Possible implausible results after changing framework data: If the difference between the two years of emissions neutrality of the two paths is zero or one and the year with the later starting year is then marked differently, the result may be distorted due to rounding (see rounding rules above). The emission neutrality points then provide the more accurate results (see bottom of main sheet).
4. Please note that temporary effects such as Corona may play a role if the country is on the right track.

Overshoot

It is possible to take a volume overshoot into account. This means that the remaining budget can be exceeded and this overshoot is offset by net negative emissions.

The potential for net negative emissions is indicated by a percentage that you can enter, which is applied to the emissions in 2019. The negative value of the result represents the minimum of the emission pathway (*E_min)*.[4] For indications of the potential and limitations for net negative emissions, please refer to: (Wolfsteiner & Wittmann, 2025d).

The percentage for determining *E_min* is entered under 'global framework data' because it is applied to all countries in the world in the web application. However, each country can basically determine for itself the potential for net negative emissions and the resulting overshoot with which it wants to comply with its national CO2 budget.

Further sheets

Sheet "big six fig"

In this sheet you will find the linear emission paths for the six major emitters and important key figures about them.

Sheet "big six NDCs"

This sheet compares the submitted NDCs for 2030 with the results in this tool. For China and India, the NDCs for 2030 can be derived using certain assumptions, as these countries have not specified any concrete targets for 2030.

Sheet "all budgets"

In this sheet you will find the corresponding national CO2 budgets for all countries in the world. The results for the six major emitters are shown separately. "Year emissions neutrality" refers to a linear emission path **with no net negative emissions from and including 2020 onwards**.

Sheet "all targets"

In this sheet you will find the corresponding national CO2 targets for all countries in the world. The results for the six major emitters are shown separately. The results refer to linear emission paths that can take a **volume overshoot into account**. The specified start year of the emission paths begins after the last year with available actual emissions.

Further tools

Analogue web app based on the EDGAR database

http://national-budgets.climate-calculator.info

Since the EDGAR database does not report CO2 emissions from land use at national level, a LUC budget must be reserved there at global level.

Detailed Excel tool for calculating national CO2 budgets

Here you will find a detailed Excel tool (Wolfsteiner & Wittmann, 2025c). There you can choose, for example, whether a global CO2 budget is to be distributed from 2016 or from 2020.

[4] If the year of the transition of the emission path into a horizontal occurs after 2100 and this horizontal is a negative value, then the formulas used lead to incorrect results. Therefore, in this case *E_min* = 0 is set. You will get a hint in the main sheet to enter a lower potential for net negative emissions if this applies to the country selected there. In the "big six" sheet, if you scroll to the right, the corresponding countries are shown. In the sheet "all targets" no value is shown for these countries.

More options for calculating Paris-compatible emission paths

With our web app http://paths.climate-calculator.info or a corresponding more detailed Excel tool (Wolfsteiner & Wittmann, 2025a), emission paths can be derived from the national budgets determined here. In addition to linear emission paths, five further scenario types are offered, thus covering the entire range of plausible possibilities (Wolfsteiner & Wittmann, 2024).

Detailed Excel tool for calculating Paris-compatible targets based on the ESPM

This tool can be used to determine Paris-compatible national CO2 budgets for all countries in the world and, with the help of the Regensburg Model Scenario Types, plausible national emission paths: (Wolfsteiner & Wittmann, 2025b).

Papers on Paris-compatible national targets (latest publications on the ESPM)

- Calculation of Paris-compatible Emission Targets for the **Six Largest Emitters** with the **Extended Smooth Pathway Model** (Sargl, et al., 2025b); here
- Calculation of Paris-compatible emission targets using the Extended Smooth Pathway Model, exemplified by **Germany** and the **EU** (Sargl, et al., 2025a); here

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