Treatment of the topics
LUC, ISA and net negative CO2 emissions
in RM and ESPM tools

Version: 15/12/2023

Current version here: http://luc.climate-calculator.info

www.save-the-climate.info

Contents

Initial situation

Here you will find an overview of our tools in which the following topics can play a role:

► https://www.climate-calculator.info.

LUC and ISA budgets

Tools for the **R**egensburg **M**odel (Wolfsteiner & Wittmann, 2023d) and some tools within the **E**xtended **S**mooth **P**athway **M**odel use the EU database EDGAR (EDGAR, 2023). This database contains the CO2 emissions of all countries in the world from the use of fossil fuels and the production of cement, with the exception of international shipping and aviation (ISA).

The results of the tools for all countries in the world therefore do not include CO2 emissions due to land-use change (LUC) and ISA.

For LUC emissions in particular, there are major substantive and methodological problems in estimating emissions for individual countries. Moreover, there are good reasons to doubt the sustainability of negative LUC emissions.

For ISA emissions, there are problems in allocating to countries.

Therefore, separate budgets for these two CO2 fractions (LUC and ISA) are set in the tools when using the EDGAR data. These budgets are subtracted from the total global CO2 budget to determine the global CO2 budget that is allocated to countries in these tools.[1]

Thus, national LUC emissions (whether net positive or net negative) are offset against the global LUC budget. This means that national negative CO2 emissions considered in the tools only refer to negative emissions in so far as they originate from the non-LUC sector.

A global LUC budget could also be divided among countries if, for example, data quality should be better. Then there would be two possibilities:

(1) At country level, two separate CO2 budgets resp. paths are calculated: one for fossil emissions and one for LUC emissions.

(2) Total CO2 emissions including LUC are considered.

Separate budgets could have the advantage that, in the event of continued major data uncertainty and doubts about sustainability for negative LUC emissions, compliance with targets could be well monitored on a relatively secure data basis, at least for fossil emissions.

Net negative CO2 emissions (NNE)

In our tools, **net negative CO2 emissions** can usually also be taken into account, which can compensate for net positive CO2 emissions.

The minimum value of emissions mostly by 2100 must be set in the tools (E_{min}).

For this purpose, most tools need to specify a percentage that is applied to the emissions in the base year. This also determines the potential for net negative emissions. If a negative[2] percentage is given, the minimum value is negative and thus represents the potential for net negative CO2 emissions.

In order to achieve **climate neutrality**, negative CO2 emissions will be needed to compensate for the emissions of other greenhouse gases that cannot be completely avoided, such as methane and nitrous oxide from agriculture. These negative CO2 emissions are not considered here; they must therefore be generated additionally.

[1] Thus, a negative LUC budget increases the budget to be distributed among countries.

[2] However, a positive percentage must be entered in the web app http://global-paths.climate-calculator.info.

Orientation values

LUC budget

The illustrative 1.5°C model paths of the IPCC could be used as orientation variables for the LUC budget; see Table 1 (IPCC, 2018).

However, especially with a negative LUC budget, the uncertainty regarding the actual potential and **sustainability** of **negative LUC emissions** must be taken into account. Furthermore, the approach of a generous negative LUC budget at the global level is problematic if no **responsibilities** are defined as to who should realise or finance it.

ISA budget

According to EDGAR, global ISA emissions in 2019 amounted to 1.3 Gt CO2 (EDGAR, 2023). These represented a 3.2% share of total global CO2 emissions of 40.9 Gt (GCP, 2023).

Potential net negative CO2 emissions from the non-LUC sector

Here again, the illustrative 1.5°C model paths of the IPCC can be used for orientation values (see Table 1). It should be noted that negative emissions in these tools can only come from the non-LUC sector. Therefore, only row 3 in Table 1 would be relevant here.

If net negative CO2 emissions are allowed ($E_{min} < 0$), the budget may be temporarily exceeded. This overshoot is then offset by net negative CO2 emissions in most tools by 2100.

The following should be noted:

- However, it should be noted this excess amount (**overshoot**) can also lead to **dangerous tipping points** in the climate system being **exceeded**.
- It should also be taken into account that the economic, technical, and sustainable **potential** of negative emissions is still very **uncertain**.
- According to recent findings, "*the century-scale climate–carbon cycle response to a CO2 removal from the atmosphere is not always equal and opposite to the response to a CO2 emission*" (IPCC, 2021, pp. 5 - 9). This potential **asymmetry** is not taken into account here.
- If the net negative emissions in the IPCC model paths also serve to **offset other greenhouse gases**, to be able to achieve climate neutrality, this would mean that the potential to offset an overshoot in CO2 emissions would be correspondingly lower.

IPCC SR1.5 illustrative model paths

	IPCC SR15 illustrative model paths for possible guidance in the ESPM or RM (in Gt)						
A	2019 total	40.9				source: Global Carbon Project	
B	2019 excl. LUC	36.3					
	2019 LUC	4.6					
C	global budget 2020 - 2100	400					
	IPCC SR15 model paths	P1	P2	P3	P4	average P1 - P4	average P1 / P2
1	∑ 2020 - 2100 LUC	-169	-230	-178	140	-109	-199
	share of C	-42%	-57%	-45%	35%	-27%	-50%
	∑ 2020 - 2100 net positive LUC	23	20	29	148	55	21
	∑ 2020 - 2100 net negative LUC	-191	-249	-208	-7	-164	-220
	2100 total	-3.5	-4.5	-13.0	-21.3	-10.6	-4.0
2	share of A	-9%	-11%	-32%	-52%	-26%	-10%
	2100 excl. LUC	0.8	-0.9	-8.9	-20.1	-7.3	0.0
3	share of B	2%	-2%	-24%	-55%	-20%	0%
	possible approaches for						
	a LUC budget 2020 - 2100	1	the potential for net negative emissions				3
							2

Table 1: IPCC SR15 model paths for possible guidance in the ESPM or RM[3]

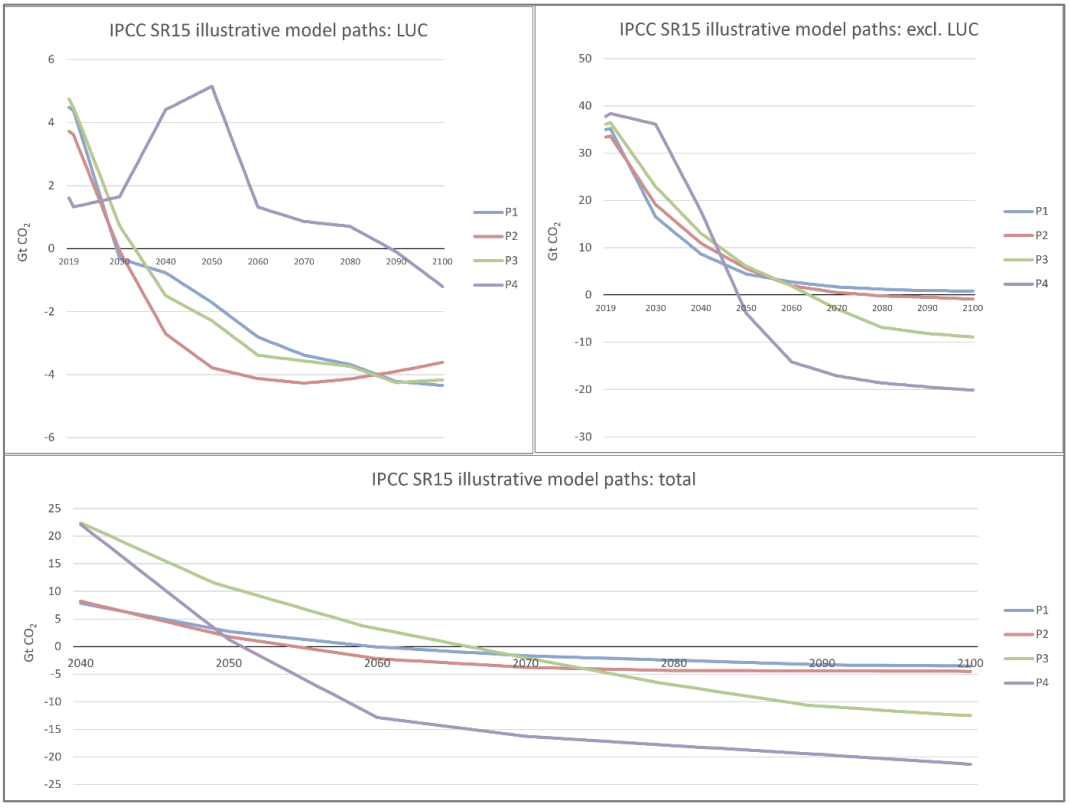

Figure 1: IPCC SR15 illustrative model paths[4]

[3] Sources: (Wolfsteiner & Wittmann, 2023c) and (GCP, 2023).

[4] Source: (Wolfsteiner & Wittmann, 2023c).

References

EDGAR, 2023. *European Commission, Joint Research Centre (JRC)/PBL Netherlands Environmental Assessment Agency. Emission Database for Global Atmospheric Research (EDGAR).* [Online]
Available at: https://edgar.jrc.ec.europa.eu/
[Accessed 20 10 2023].

GCP, 2023. [Online]
Available at: https://globalcarbonbudget.org
[Accessed 05 12 2023].

IPCC, 2018. *Special Report 1.5°C. Chapter 2: Mitigation pathways compatible with 1.5°C in the context of sustainable development.* [Online]
Available at: https://www.ipcc.ch/sr15/

IPCC, 2021. *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change.* [Online]
Available at: https://www.ipcc.ch/report/ar6/wg1/

Wolfsteiner, A. & Wittmann, G., 2023a. *Tool for the Calculation of Emission Paths with the RM Scenario Types.* [Online]
Available at: https://doi.org/10.5281/zenodo.4568839

Wolfsteiner, A. & Wittmann, G., 2023b. *Tool for the Calculation of Paris-compatible Emission Paths with the ESPM.* [Online]
Available at: https://doi.org/10.5281/zenodo.4580310

Wolfsteiner, A. & Wittmann, G., 2023c. *Tool for the Calculation of Paris-compatible Global Emission Paths with the RM Scenario Types.* [Online]
Available at: https://doi.org/10.5281/zenodo.4584562

Wolfsteiner, A. & Wittmann, G., 2023d. *Tool for the Calculation of Paris-compatible National Emission Paths with the Regensburg Model.* [Online]
Available at: https://doi.org/10.5281/zenodo.5846043

Wolfsteiner, A. & Wittmann, G., 2023e. *Tool: Implicit and explicit weighting of the population in the allocation of a global CO2 budget.* [Online]
Available at: https://doi.org/10.5281/zenodo.5837866