

**Instructions
for the tool:
Global Paths
based on
RM Scenario Types**

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The latest version of the tool can be downloaded at: www.save-the-climate.info

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1 Basic idea behind the tool “global paths”

The tool offers the Regensburg Model Scenario Types RM 1 - 6 to derive plausible global paths 2020 - 2100 that adhere to a global budget 2020 - 2100. This scenario types cover the range of plausible possibilities well.

2 Brief introduction to the tool

In the **sheet 'base data'** you can set the basic conditions such as the budget which is to be met, and the minimum value of global annual emissions (potential for net negative emissions).

For deriving **global paths** the tool offers the scenario types **RM 1 - 6**. There differ in particular in terms of different assumptions on the trajectory of annual reduction rates resp. reduction amount.

When modifying input data (which the cells shaded in yellow are designated for), you must always execute the **macro** in the **sheet 'goal seek'** to adjust the free parameter in the scenarios such as to meet the global budget 2020 - 2100 which is set out in sheet 'base data'.

3 Entries in the sheet ‘base data’

- A. In a first step, a **global budget 2018 - 2100** is set that can be based on the remaining budgets according to the IPCC (see table 2.2 of the IPCC SR15 in the sheet).
- B. **Emissions 2018 and 2019**. You can enter a rate of change for the expected change in emissions in 2019. We took the actual emissions for 2018 from the Global Carbon Projects database.
- C. **Global CO2 budget 2020 – 2100**: Emissions from 2018 and 2019 are deducted from the budget 2018 - 2100.
- D. **Global minimum emissions**:
Here you can specify which minimum the global paths can achieve in 2100 (E_{min}). If you specify a negative value, this means net negative emissions.
The sheet also shows suggestions for E_{min} based on the illustrative IPCC model paths P1 and P2. Note: Paths P 3 and P4 have significantly higher net negative emissions.

Please note the basic comments on negative emissions in this sheet.

4 Determination of emission paths

4.1 Where and how the paths are determined

The emission paths are determined using the scenario types RM 1 – 6. The paths are essentially determined by **specifying** the **annual** rate of **change** (RM 1 - 5) or the annual constant reduction amount (RM-6).

The paths are calculated in the **sheet ‘scenarios’**.

In scenarios RM 2 - 5, the rate of change for 2020 (RR_{20}) is an input value in the sheet ‘goal seek’. The average global change rates last three years is given in this sheet as an orientation.

In scenarios RM 1 - 5 for the transition to **net negative emissions**, a constant reduction amount is applied from a predefined threshold (TV). The last reduction amount before the threshold is reached is then used. The **change of method** is necessary, because net negative emissions cannot be implemented by determining the reduction rates. Different threshold values can be set for scenario type RM-1 and scenario types RM 2 - 5. In scenario type RM-1, a higher threshold value can be useful in order to achieve faster net negative emissions. By entering the TV , you can freely choose when the method should be changed.

If the path reaches E_{min} , this value is continued until 2100.

In the **sheet ‘goal seek’** the **free parameter** of the respective scenario is determined so that the budget 2020 - 2100 is adhered to (target value search). The macro ‘goal seek’ in this sheet uses the target value search integrated in Excel.

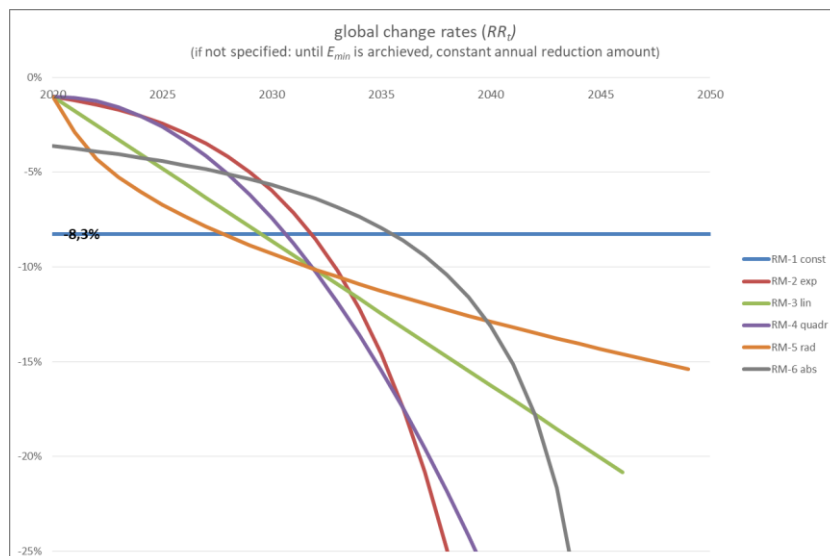
This usually leads to the following **three phases** for determining the paths:

1. Application of the annual reduction rates (RM 1 - 5) or the annual reduction amount (RM-6).
2. Annual emissions less than or equal to TV : The last annual absolute reduction is continued in RM 1 - 5.
3. Minimum for the annual emissions (E_{min}) specified in the sheet ‘base data’.

These three phases can be found in the formula for the annual emissions in the individual scenario types in the sheet ‘scenarios’.

4.2 Description of the RM Scenario Types 1 – 6

The following figure shows an example of the property of the scenario types:



The scenarios differ based on the assumptions about property of the annual changes.

(1) RM 1 - 5: Assumption about the course of the **annual rates of change**:

- **RM-1-const:** A **constant annual reduction rate** is assumed.
- **RM-2-exp:** An **exponential increase** of the annual reduction rates is assumed. The initial reduction rate for 2020 (*RR_20*) must be entered. In this scenario type, no positive change rate 2020 can be used. The reduction rate is escalated annually. Initially, the reduction rates increase¹ less than proportionally.
- **RM-3-lin:** A **linear increase** of the annual reduction rates is assumed. For the year 2020, an **initial value** (*RR_20*) must be set.
- **RM-4-quadr:** A **quadratic formula** for the annual reduction rates is used. The initial value (*RR_20*) must be set. Initially, the reduction rates increase less than proportionally.
- **RM-5-rad:** A **radical formula** for the annual reduction rates is used. The initial value (*RR_20*) must be set. Initially, the reduction rates increase more than proportionally.

(2) **RM-6 abs:** A **constant annual reduction amount** is assumed. This scenario type starts with a relatively high reduction rate. Then the reduction rates initially increase less than proportionally and slowly, in the end increasing very quickly.

4.3 Formulae of the RM Scenario Types 1 – 6

For a comprehensive mathematical description, we refer to our paper "Mathematical Description of the Regensburg Model Scenario Types RM 1 - 6", which you can download from our website save-the-climate.info or use this direct [link](#) to the PDF.

4.4 Macro in the sheet ‘goal seek’

The **macro ‘goal seek’** tries to determine the free parameter in the scenario (row 12 or 13) so that the global budget (row 16) is adhered to (► row 15 = row 16). The macro also ensures that the constraints for the free parameters are met.

If this does not work straight away, the macro tries to find a solution with a lower rate of change for 2020 (for example: -2.5% instead of -2%). The start value you specified is therefore changed. If a solution cannot be found either, the macro will inform you and advise you to change the start value for 2020 more significantly or to change the threshold value (*TV*).

In the **sheet ‘graphs’** you can see the graphical **results**.

5 IPCC illustrative paths P1 – P4

In the sheet 'IPCC SR15 graphs' we show for comparison the illustrative model pathways that the IPCC published in its 2018 special report.

¹ “Rising reduction rates” are to be understood here in such a way that the absolute amount increases.