Applying Carbon Law From 2025

Summary of Klimatkollen's investigations for adjustments to the Carbon Law target trajectory, based on 2024 emissions and updated carbon budgets.

Elvira Boman, Frida Berry Eklund and Kayla Woodbury, June 19, 2025

"Go beyond 1.5°C warming, a place our civilisations have never experienced and Earth has not seen in the last 100,000 years, and we will not only see major human and economic damage, but are likely to cross multiple Earth system tipping points, causing amplified warming with billions of people affected." – Johan Rockström

About Klimatkollen's Carbon Law Investigation

This investigation lays out Klimatkollen's proposal to apply an adjusted target trajectory for Carbon Law, from 7% per year to 12% per year, based on the fact that the world failed to peak emissions in 2020 putting the world five years off the original trajectory of the Carbon Law pathway. The proposal is based on 2024 global carbon dioxide emissions and an updated carbon budget starting 2025.

The aim of this paper is to investigate what the failure to peak emissions in 2020 means for the remaining carbon budget to stabilise temperature to about 1.5°C – and how this translates to an updated Carbon Law target trajectory. Klimatkollen aims to use the target trajectory to illustrate what a Paris-aligned path towards near zero looks like for the 300 corporate data visualizations published on Klimatkollen.se today, as well as more companies being added through a collaboration with Zurich University. The visualizations will be communicated clearly to a broad public audience.

Context

It's code red for humanity. At current emission levels, we will smash through the remaining carbon budget for keeping global warming below 1.5°C in only six years, as stated in the Global Carbon Budget 2024. However, according to a recent Johan Rockström article (March 2025), that drops to only four years, if we want a two in three probability (67%) chance of success instead of a 50:50 chance. This is hardly surprising given that 2024 already reached 1.5°C for the first time. For the 1.5°C target to be fully breached, scientists look at ten-year averages.

Klimatkollen is a Swedish non profit organisation and citizen platform, publishing climate-related data about Swedish municipalities and companies. Our goal is to create the public pressure needed on decision makers to cut emissions in line with the Paris Agreement. To this end we publish data and visualizations aimed at a broad public audience, and work with media and partners to raise awareness and spark action.

As a citizen-led organisation, our role is to base our calculations and visualisations on established frameworks (Paris Agreement, CSRD), standards (GHG Protocol) and best available science (IPCC, The Potsdam Institute, the Global Carbon Project and more).

It is also our role to communicate in a way that creates change. We are not a scientific body, a research institution or profit-driven initiative. Our mission is to lay out the current predicament clearly, speak truth to power, use public communication tools, and show facts as they are.

Klimatkollen is therefore exploring an adjusted Carbon Law target trajectory as a rule of thumb to hold both state, regional and municipal bodies, as well as companies, accountable for living up to the Paris Agreement and the deep, fast and long-lasting emission cuts that are needed.

Rationale for communicating using an adjusted Carbon Law target trajectory:

1. We aim to reach a broad climate-interested audience. Visualisations need to be simple, understandable and actionable – as well as shareable on social media.
2. We aim to communicate clearly what the Paris Agreement means in practice. A rule of thumb, such as Carbon Law, that can be applied on all entities is a great way to do this, as it opens up a space for entities themselves to respond.
3. Every fraction of a temperature degree counts, it's never "too late", and we aim to show the state of play clearly, whilst encouraging action.

All paths forward for humanity are based on assumptions about justice, equity and risk. We will communicate transparently about our method and why we chose to visualise one way or another.

About Carbon Law

The Global Carbon Law, proposed by Johan Rockström, Owen Gaffney and Johan Falk in 2017, is a science-based framework that outlines a pathway for how the world can limit global warming to well below 2°C. Inspired by Moore's Law (which predicts exponential growth in computing power), the Carbon Law calls for an exponential reduction in global carbon dioxide (CO_2) emissions.

This exponential trajectory is designed to align with the Paris Agreement goals, offering a simple, scalable, and science-based roadmap for governments, businesses, and cities.

The Global Carbon Law has influenced policy frameworks, corporate targets (e.g., the Exponential Roadmap Initiative), and scientific discussions on feasible pathways for climate stabilization.

Core Concept:

1. Halve global CO_2 emissions every decade from 2020 onward.
2. Double carbon removal technologies and capacity every decade.
3. Reach net-zero emissions by around 2050.

Three Pillars of Action:

1. Carbon-neutral energy: Rapid phase-out of fossil fuels, 100% renewable energy systems.
2. Green infrastructure and industry: Electrification, energy efficiency, circular economy.
3. Carbon sinks and removal: Transforming agriculture, protection and restoration of ecosystems, and scaling carbon capture.

Key Characteristics:

- Exponential framework: Emphasizes speed and predictability.
- Applies at all levels: Global, national, corporate, and individual actors can adopt similar "halving" rules.
- Enabler for innovation: Encourages a tech-driven transition and signals urgency.

Methodology

Going into this investigation we have a series of assumptions and baseline numbers we are using in order to calculate new exponential reductions rates to use as a rule of thumb for the adjusted Carbon Law target trajectory.

1. Timeline

The starting year is 2025 and the end year is 2050.

2. Starting Emissions

We are basing our calculations on the 2024 fossil CO_2 emissions, estimated at 37.4 $GtCO_2$ (Global Carbon Budget 2024).

3. Reduction Rate

We assumed an exponential reduction rate rather than linear. The main reason for this is to: have an emission reduction pace that is the same every year, is good for public communication, and will also mean a faster decrease in CO_2 emissions emitted in the near term. This recognises that it is feasible to make big emissions cuts early on – the "low-hanging fruit".

We assumed some amount of residual CO_2 emissions by 2050. The general guidance from IPCC is to aim for 90-95% in emissions reductions with 5-10% to be compensated, i.e. with Carbon Dioxide Removal (CDR). Due to uncertainty here, we have used an estimate of 5.5 $GtCO_2$ residual emissions at 2050, as referenced in the 2023 article "All options, not silver bullets, needed to limit global warming to 1.5 °C: a scenario appraisal". This is the estimated upper limit of plausible CDR.

We have chosen to focus on anthropogenic fossil CO_2 emissions only. However, other greenhouse gases have a significant impact on the climate, and we expect a similar reduction pace is needed for these emissions.

4. Principles

The original Carbon Law was based on three key principles (see core concept above). Since we are 5 years behind schedule, we are not factoring in the original Carbon Law idea of halving emissions every ten years.

However, the other two principles remain central to our framework: respecting the constraints of the remaining global carbon budget, and reaching net-zero emissions by 2050.

The goal of keeping global warming well below 2°C is interpreted here as having at least a 50% chance of limiting warming to 1.5°C, although we also show the estimated calculations for 1.7 and 2 degrees in the table below, again with a 50:50 probability. This is accepting a very high degree of risk, however, the remaining carbon budget is now so small it is not plausible to increase the probability of success without global economic collapse.

Results

The table below shows carbon budgets for 50% chance of staying below 1.5, 1.7 and 2°C of global warming (above the 1850–1900 pre-industrial levels). These numbers show the adjusted IPCC budget (AR6 RCB) from the Global Carbon Budget 2024 with results applied from January 2025 to 2050.

Global warming above pre-industrial levels (in °C)	**50% chance carbon budget ($GtCO_2$)**	**Reduction rate needed (in % per year)**
1.5	305	11.72
1.7	655	7.38
2	1,155	7.38

With CDR estimated at **5.5 $GtCO_2$ by 2050** (see method note above), the minimum emission reduction rate required is **11.7%**, **per year, for the 1.5 °C case,** to stay within the 305 $GtCO_2$ budget.

For staying within the **1.7°C or 2°C** budget with 50% probability and with CDR estimated at **5.5 $GtCO_2$ by 2050**, the reduction rate becomes **7.4%**.

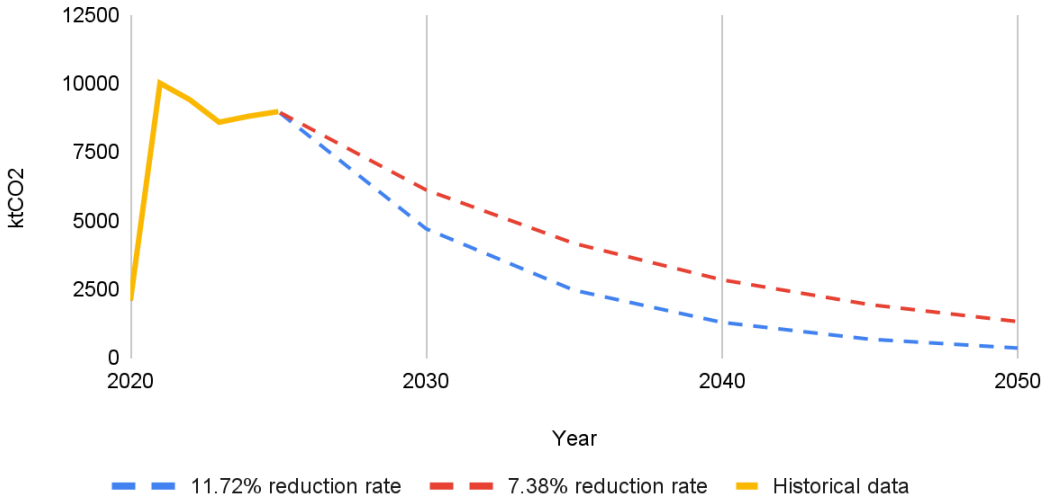
Application of results

Achieving near zero emissions, with a CDR of 5.5 $GtCO_2$/yr at 2050, requires a steep reduction rate for the 1.5°C carbon budget. We also present the required reduction rate for a 1.7°C carbon budget in our proposal, to visually illustrate the differences between 1.5°C and 1.7°C.

The figures below show two examples of reductions rates of 11.7% and 7.4% for H&M, ABB, IKEA and Ericsson respectively. Reduction paths for the 1.5°C and 1.7°C carbon budgets are denoted with blue and red dashed lines, respectively, and reported emissions for scopes 1, 2 and 3 combined is the solid yellow line in the figures.

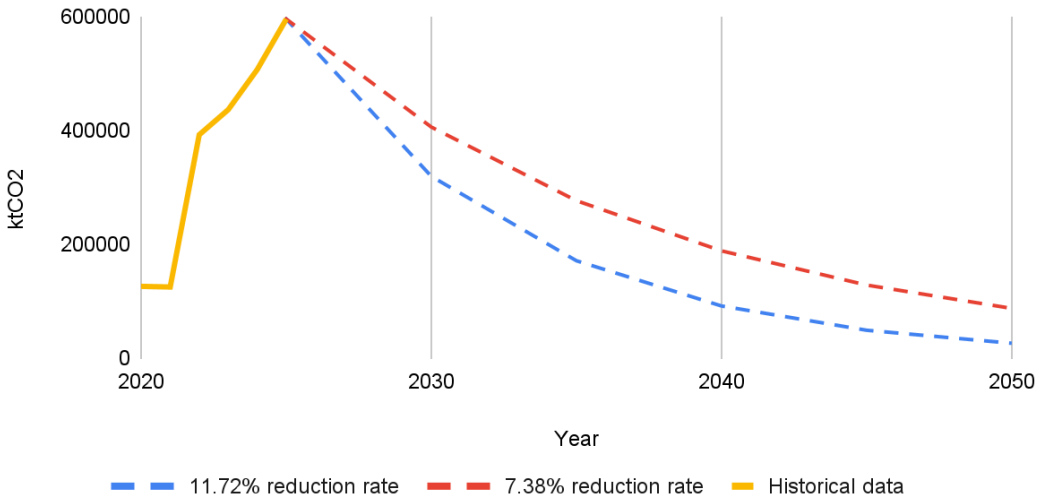
H&M

Annual cuts match the 1.5°C (blue) and 1.7°C (red) budgets, assuming 5.5 $GtCO_2$ CDR by 2050



ABB

Annual cuts match the 1.5°C (blue) and 1.7°C (red) budgets, assuming 5.5 $GtCO_2$ CDR by 2050



Proposal

We are now five years behind the original Carbon Law, and running out of carbon budget. We should do our utmost to get on that trajectory - and cut CO_2 emissions, as well as methane and other greenhouse gases, simultaneously scaling up solutions and carbon removals.

Given the scale of the risks, and the uncertainties regarding carbon budgets and feasibility of CDR, we suggest an updated Carbon Law rule of thumb of *halving emissions every five years*, starting 2025, with an aim to *double the emissions reduction efforts* from when Carbon Law was first conceived. This approximates to annual **12%** emission cuts, starting 2025. This is based on the adjusted IPCC budget, assuming residual emissions of 5.5 $GtCO_2$, and based on a 50% chance of not exceeding 1,5°C.

The annual 12% reduction pace does not take into account *equity* or individual entities' *ability to transform their operations*, but should be used as a rule of thumb to illustrate the pace needed globally to have a chance of limiting global warming to 1.5°C.

References

Global Carbon Budget 2024
A roadmap for rapid decarbonization, Johan Rockström, Owen Gaffney, Joeri Rogelj, Malte Meinshausen, Nebojsa Nakicenovic, Hans Joachim Schellnhuber (2017)
Is the Earth losing resilience, and does it matter? Part 1: The risks we don't know we're taking, Johan Rockström, 28 March 2025
Forest carbon budgets and Finnish climate policy: explaining my position, Johan Rockström, 11 March 2025
Understanding the carbon dioxide removal range in 1.5°C compatible and high overshoot pathways, Ruben Prütz, Jessica Strefler, Joeri Rogelj and Sabine Fuss (2023)
All options, not silver bullets, needed to limit global warming to 1.5 °C: a scenario appraisal, Lila Warszawski, Elmar Kriegler, Timothy M Lenton, Owen Gaffney, Daniela Jacob, Daniel Klingenfeld, Ryu Koide, María Máñez Costa, Dirk Messner, Nebojsa Nakicenovic (2023)
Global Energy Review 2025, IEA
1.5°C Business Playbook, The Exponential Roadmap Initiative
A roadmap for rapid decarbonization, Johan Rockström, Owen Gaffney, Joeri Rogelj, Malte Meinshausen, Nebojsa Nakicenovic, Hans Joachim Schellnhuber (2017)

Contact

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Annex: Calculations

We assume emissions decline **exponentially** starting in 2025:

$$E_t = E_0 * r^t$$

Where:

- E_t = emissions in year t (with t = 0 in 2025)
- E_0 = emissions in 2025 (37.4 $GtCO_2$)
- r = annual retention rate (i.e. 1 - reduction rate)
- $t \in [0, 25]$ for 2025–2050

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1. Total Cumulative Emissions (Budget Constraint)

We calculate total emissions from 2025 to 2050:

Cumulative Emissions = $\sum_{t=0}^{n} E_0 * r^t = \frac{E_0(1-r^{n+1})}{1-r}$

This sum must be **less than or equal to the carbon budget**, B, e.g.:

- B = 305 $GtCO_2$ for 1.5°C
- B = 655 $GtCO_2$ for 1.7°C

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2. Final Year Target

We optionally constrain the emissions in the final year (2050):

$$E_{2050} = E_0 * r^{25} \leq \epsilon$$

Where ϵ is be:

- 5.5 $GtCO_2$

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3. Constrained optimization (fixed endpoint)

Find the maximum r such that:

$\frac{E_0(1-r^{n+1})}{1-r} \leq B$ and $E_0 * r^n \leq \epsilon$

This gives us the **exponential decline** that still hits both the **budget** and **final-year target**.

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5. Result

Once r is found:

- **Annual reduction rate** = 1 − r
- **Final emissions** = $E_{2050} = E_0 * r^{25}$
- **Total emissions** = $\sum E_t$ as above