

Carbon Budget Briefing Note 1 (CBBN1)

A new set of Paris Compliant CO₂-Budgets for Sweden

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1. Introduction and Key Message

The publication of the IPCC's Sixth Assessment Report (AR6) in August 2021 [1], presented a new and updated suite of global carbon budgets. This briefing note uses these as basis for developing a new set of Paris-compliant carbon budgets for Sweden.

The key message of this analysis is that for Sweden to deliver on its Paris-commitments, it would need to decrease its CO₂ emissions by a minimum of 12% per annum for a 2°C future and 21% for 1.5°C.

The estimates of Sweden's territorial carbon budget within this briefing note (CBBN1) are for energy-related CO₂ emissions, including international bunkers (i.e. shipping and aviation).

2. Headline carbon budgets and mitigation rates

(these values remain provisional and subject to refinement)

Interpretation of Paris Agreement	Carbon budget MtCO ₂	Approx. Years of current emissions	Annual emission reductions with exponential decline	Zero CO ₂ date with linear emissions reductions
50% chance of 1.7C	355 (305)	7.5 (6.5)	12% (15%)	2037 (2035)
50% chance of 1.5C	170 (125)	3.5 (2.5)	21% (38%)	2029 (2027)

Table 1: Sweden's Paris-compliant carbon budgets starting January 1st, 2022 (and 2023 in brackets). These values are for energy-related territorial CO₂ emissions, including international bunkers (aviation & shipping) and excluding cement process emissions. Data is based on AR6 [1], Anderson *et al.* [2] and Statistics Sweden [3].

3. How does 50% of 1.7°C relate to the Paris “well below 2°C” commitment?

The IPCC’s latest carbon budget for a 50% chance of 1.7°C is very similar (within 6%) of that for an 83% chance of 2°C. Given the innate uncertainties in the carbon budgets, for all reasonable purposes the 1.7°C budget and attendant mitigation rates described in this briefing note can be said to adequately reflect those required to deliver on the Paris “well below 2°C” commitment. [4]

However, when it comes to the tighter framing of Paris, guided by “pursuing ... 1.5°C” (taken here as a 50% chance of not exceeding 1.5°C), it is important to note that the IPCC’s headline global carbon budget for 1.7°C is 70% greater than that for 1.5°C. This increases to 80% for 2°C.

4. How did we estimate Sweden’s post 2022 Carbon Budgets?

These new carbon budgets for Sweden are estimated using the method detailed in Anderson *et al.* [2]. This approach started from a translation of the Paris Agreement’s temperature commitments (“well below 2°C” and “pursuing ... 1.5°C”) into a single commitment of a 50% chance of 1.7°C. From here, it apportioned the IPCC’s headline global carbon budget for a 50% chance of 1.7°C between the “developing” and “developed country parties” (following the classification and language of the Paris Agreement [4]). The process was guided by a combination of feasibility and the UNFCCC’s formal framing of equity (i.e. the principle of “common but differentiated responsibility and respective capabilities”; CBDR-RC [5]). The budget thus derived for “developed country parties” was subsequently downscaled to individual nations on the basis of their ‘grandfathered’ emissions (an approach that most appropriately captures a range of key issues, e.g. from population to structural lock-ins).

The Swedish budgets provided here follow the same method as Anderson *et al.* [2], but update the previous values, using, 1) the IPCC’s latest AR6 global budgets [1], 2) Sweden’s 2020 and 2021 emissions, extrapolated from Statistics Sweden data [3]. Sweden’s emissions in 2021 are assumed to be 5% higher than they were in 2020, based on the three quarterly emissions reports for 2021, published by Statistics Sweden (see for example [5]).

Another key assumption in this update relates to the 20% increase in the size of the AR6 carbon budget for a 50% chance of 1.7°C [1], compared with that in SR1.5 [7]. In this briefing note, the larger global carbon budget is allocated evenly across all nations (i.e. all national budgets are increased by 20%). It is worth noting that from the perspective of international equity this simple allocation tends to favour wealthier developed nations at the expense of poorer industrialising and developing nations. Consequently, any Swedish carbon budgets provided here should be considered the minimum that needs to be delivered if Sweden is not to renege on its commitments enshrined in the Paris Agreement.

5. Extending the analysis to include 1.5°C

Since the Paris Agreement, there has been an evident strengthening of the “pursuing ... 1.5°C” commitment. This was initially through an improved understanding of the severity of the impacts at 1.5°C and 2°C (captured in the IPCC’s SR1.5 [7]), subsequently through the 1.5°C focus of the G7 Communiqué [8] and latterly the “keep 1.5°C alive” framing of COP26 [9].

Responding to this tightened commitment, an estimate of Sweden’s fair contribution to a 50% chance of not exceeding 1.5°C is included in the headline budgets of this briefing note. The global 1.5°C budget is again taken from AR6 [1], downscaled to Sweden simply by reducing Sweden’s national 1.7°C budget (i.e. the updated value from [2]) in proportion to the difference between the global 1.7 and 1.5°C budgets. Whilst this method may miss some of the more nuanced differences in apportioning a smaller global budget between nations, it is sufficiently robust for the purposes of this briefing note. Nevertheless, it is important to understand that the results presented for 1.5°C (and, to a lesser extent, 1.7°C) remain provisional and will be subject to future refinement. That said, in the absence of a fundamental shift in the scale of the carbon budgets provided by the IPCC’s AR7 (2027/8) or in an interim IPCC “Special Report”, it is difficult to foresee any circumstances that would see a Paris-compliant mitigation agenda for Sweden be very different from that provided here.

6. Be warned of the consequences of delay

The new headline budgets provided in this briefing note are valid from the start of 2022. However, as is evident in the accompanying 2023 values (provided in brackets in Table 1), if Sweden fails to deliver significant cuts in absolute emissions during 2022, then the mitigation required from 2023 is much more onerous. Based on a simple exponential decline, for 1.7°C, it equates to an increase in the annual mitigation rate of around 25%, i.e. from 12% to 15% p.a.). For the 1.5°C budget, the mitigation rate increases from a hugely challenging 21% p.a. to an impossible 38%.

7. Consideration of international equity

The 1.5 to 2°C carbon budgets are now so depleted that equity between nations cannot be delivered through differential mitigation alone. In this regard, and with practicality still guided by principles of equity, the best that can be achieved is the ‘least unfair distribution’ of the remaining global carbon budget.

This is a highly inequitable and far from satisfactory position. In large part this situation has come about because the nations with the greatest historical emissions have so far abdicated their “common but differentiated responsibility” [6] to rapidly cut their emissions. The upshot of this failure is that substantial levels of financial assistance and reparations are now required, if poorer nations are to deal with the climate impacts knowingly imposed on them while simultaneously developing their societies without recourse to growing fossil fuel consumption.

8. How confident are we in our findings?

It is certainly possible to ‘fine tune’ some of the assumptions that underpin our analysis. However, within the tight IPCC carbon budgets for 1.5–2°C, and with serious attention paid to the UNFCCC framing of equity [6], the budgets outlined here are sufficiently robust to provide a strong guide to Sweden’s mitigation policy.

A potential exception to this is whether it is considered appropriate or not to expand the IPCC’s carbon budgets through future ‘Carbon Dioxide Removal’ (CDR), deployed at planetary scale and principally in the second half of the century. Specifically, in relation to emissions of carbon dioxide from the energy sector, the inclusion of highly-speculative-at-scale CDR is judged inappropriate, as it works against the tenets of precaution. Moreover, whilst CDR is now ubiquitous in mitigation analyses, the

IPCC's estimates of additional feedbacks, potentially reducing carbon budgets, are seldom if ever included. For this analysis, a conservative approach is adopted, neither easing the mitigation burden through CDR nor increasing it through additional feedbacks.

9. Acknowledgements and further information

The research and analysis behind this briefing note were made possible through funding from the Swedish Energy Agency for the project *Regional carbon budgets and rapid transition to a fossil-free energy system* (project number 46532-1). Over the past five years, some forty municipalities, counties and regions in Sweden have had regional carbon budgets developed, building on principles and method as outlined in this briefing note.

For more information on the development of a national carbon budget for Sweden, see the paper by Anderson *et al* [2]. If issues remain, contact the authors of this briefing note.

For direct inquiries about establishing a regional carbon budget (for Kommun, Region or Län) contact the not-for-profit Klimatsekretariat (www.klimatsekretariatet.se); they are experts in developing, digitalising, visualising and updating regional carbon budgets within Sweden.

10. References

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