

# Determining Sweden's Fair Share Contribution under the Paris Agreement

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Sweden is among the 193 Parties to the Paris Agreement. Under this international instrument, parties have collectively agreed to hold warming “well below 2°C” and to “pursue efforts to limit warming to 1.5°C”, and to do so in light of equity and the principle of common but differentiated responsibilities and respective capabilities.

This report assesses Sweden's fair and ambitious contribution to the collective goal of the Paris Agreement. A fair and ambitious emissions allocation for Sweden implies the equivalent of reducing Sweden's net emissions<sup>1</sup> by 13 to 18% per year until the achievement of net zero greenhouse gas emissions around 2025 and a 2030 emission level of -20 to -52 Mt CO<sub>2</sub>e.

These rates of reduction should be interpreted as a dual obligation - to set an ambitious domestic emission reduction target as well as to provide adequate support for mitigation in developing countries, to close the gap between the domestic emission reduction target and the fair share target.

<sup>1</sup> Unless specified otherwise, all references to emissions in this report are for the Kyoto basket of greenhouse gases (CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O, and fluorinated gases), excluding emissions from land use, land use change, and forestry (LULUCF). The IPCC's 2019 Special Report on Climate Change and Land noted that “Land is simultaneously a source and sink for several GHGs,” and it is “impossible with any direct observation to separate direct anthropogenic effects from non-anthropogenic (indirect and natural) effects in the land sector” (IPCC, 2019). As a result, there are significant uncertainties inherent in the estimation of Land Use, Land Use Change and Forestry (LULUCF) emissions. In addition to these high uncertainties, there is also no common accounting framework for LULUCF emissions under the UNFCCC and different countries have adopted different accounting approaches for counting LULUCF emissions and removals towards their NDCs. Countries also use different definitions of “managed land” to identify those LULUCF emissions and removals that are assumed to be anthropogenic, with the result that it is not always possible to compare countries' reported LULUCF emissions on a ‘like with like’ basis (IPCC, 2019). Link to IPCC's 2019 Special Report: <https://www.ipcc.ch/srcccl/>

## Introduction

The 2015 Paris Agreement sets the objectives for global climate action, and a framework to facilitate the achievement of these objectives. 193 countries, including Sweden, have ratified the Agreement, committing to a collective goal of “Holding the increase in global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C” (Article 2.1(a))<sup>2</sup> and to do so in the context of equity and the principle of common but differentiated responsibilities and respective capabilities (Article 2.2, Article 4.1, Article 4.3, among others).

Assessing Sweden’s fair contribution towards the achievement of the climate objectives of the Paris Agreement is a two-step process. First, we need to identify global emission pathways that are consistent with the climate objectives of the Paris Agreement. Second, we need to determine how to allocate these emissions to individual countries, recognizing that countries have differing responsibilities for causing the problem.

## Identifying pathways consistent with the Paris Agreement

Article 2.1(a) of the Paris Agreement, which is also referred to as the long-term temperature goal (LTTG) expresses a single goal, with two textually-linked temperature levels<sup>3</sup>, which are to (a) hold warming well below 2°C and (b) pursue efforts to limit warming to 1.5°C. Two criteria have been suggested in the academic literature to identify global emission pathways that are consistent with these two levels<sup>4</sup>:

- Criterion I (pursue efforts to limit warming to 1.5°C): Pathways should not ever have a greater than 66% probability to exceed 1.5°C, and should bring global mean temperature below 1.5°C again in case of a temporary overshoot.
- Criterion II (hold warming well below 2°C): Pathways should be very likely (90% chance or more) of not ever exceeding 2°C.

The most recent and comprehensive assessments of emission reduction pathways are the IPCC’s 6<sup>th</sup> Assessment Report (AR6)<sup>5</sup> published earlier this year (March 2022), and the Special Report on 1.5°C (SR1.5) published in 2018. In both reports, pathways are categorised according to their likelihood of keeping warming below a certain level (e.g., 1.5°C). The pathways that are closest to achieving Criteria I and II above are so-called “low overshoot” 1.5°C pathways. In the AR6 report, these pathways are referred to as “C1: limit warming to 1.5°C (50%) with no or limited overshoot”. In these pathways, global greenhouse gas emissions are reduced by 43% (median, with 5-95% range of 34-60%) below 2019 levels by 2030 (Table SPM 2)<sup>6,7</sup>.

<sup>2</sup> UNFCCC, *Decision 1/CP.21 Adoption of the Paris Agreement* (2015).

<sup>3</sup> Lavanya Rajamani & Jacob Werksman, *The legal character and operational relevance of the Paris Agreement’s temperature goal*, 376 PHILOS. TRANS. R. SOC. A MATH. PHYS. ENG. SCI. (2018).

<sup>4</sup> Carl-Friedrich Schleussner et al., *Science and policy characteristics of the Paris Agreement temperature goal*, NAT. CLIM. CHANG. (2016); Carl-Friedrich Schleussner et al., *An emission pathway classification reflecting the Paris Agreement climate objectives*, 3 COMMUN. EARTH ENVIRON. 135 (2022), <https://www.nature.com/articles/s43247-022-00467-w> (last visited Jun 28, 2022).

<sup>5</sup> K Riahi et al., *Mitigation pathways compatible with long-term goals.*, in IPCC, 2022: CLIMATE CHANGE 2022: MITIGATION OF CLIMATE CHANGE. CONTRIBUTION OF WORKING GROUP III TO THE SIXTH ASSESSMENT REPORT OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (P R Shukla et al. eds., 2022).

<sup>6</sup> IPCC, *Summary for Policymakers*, in CLIMATE CHANGE 2022: MITIGATION OF CLIMATE CHANGE. CONTRIBUTION OF WORKING GROUP III TO THE SIXTH ASSESSMENT REPORT OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (P R Shukla et al. eds., 2022).

<sup>7</sup> Note that this estimate includes LULUCF emissions, and is used only for illustrative purposes.

## Assessing a fair share contribution at the country-level

Identifying whether a country is pledging a fair contribution to a global emission pathway consistent with the long-term temperature goal of the Paris Agreement (explained above), requires a framework to operationalise the notion of “equity, and the principle of common but differentiated responsibilities and respective capabilities”. An example of a question such an inquiry would aim to answer is whether an emission reduction target for Sweden that matches the global average emission reductions required by 2030 in the 1.5°C compatible pathways highlighted above (43% below 2019 levels) can be considered a fair contribution under the Paris Agreement.

While there is no consensus in the scientific literature on how to operationalise the notion of equity, there is consensus that allocating the same global average contribution of emission reduction targets to all countries (43%) would lead to “grandfathering”<sup>8</sup> emissions, an approach that is considered highly inequitable<sup>9</sup>. Given this lack of consensus on how to operationalise equity, we employ the framework adopted by the Climate Action Tracker (CAT)<sup>10</sup>, as well as its application in a peer-reviewed publication that estimated national fair emission reduction targets within the principled framework of International Environmental Law<sup>11</sup> (please see the Section 3.2 “Data and analysis steps” which explains the differences in implementation).

The Climate Action Tracker equity framework is based on a database of published equity estimates, including over 40 studies that were assessed in the IPCC’s 5<sup>th</sup> Assessment Report (AR5) based on the work of Höhne et al., (2013)<sup>12</sup>, and studies that have been published since<sup>13</sup>. These estimates are categorised according to different viewpoints (**Figure 1**). A fair share emissions range is constructed for each country, applying a weighting scheme that reflects each category in **Figure 1** equally. For each country, a common position in their respective fair share ranges is found, such that the global emission pathway obtained by summing up these estimates results in the achievement of the desired temperature goal. For further details on the approach employed, please see <https://climateactiontracker.org/methodology/cat-rating-methodology/fair-share/>.

<sup>8</sup> In the context of climate change mitigation, this term has been used to refer to the allocation of emissions rights or mitigation obligations to individual countries in amounts that are in proportion to their current emissions. This approach, which favours developed countries, avoids any weight being given to the historical responsibility, capacity etc. of these countries and is therefore regarded as being inconsistent with any principle of equity.

<sup>9</sup> Sivan Kartha et al., *Cascading biases against poorer countries*, 8 NAT. CLIM. CHANG. 348–349 (2018); Lavanya Rajamani et al., *National ‘fair shares’ in reducing greenhouse gas emissions within the principled framework of international environmental law*, 21 CLIM. POLICY 983–1004 (2021), <https://www.tandfonline.com/doi/full/10.1080/14693062.2021.1970504> (last visited Nov 15, 2021).

<sup>10</sup> Climate Action Tracker, *Fair share* | Climate Action Tracker (2022), <https://climateactiontracker.org/methodology/cat-rating-methodology/fair-share/> (last visited Aug 1, 2022).

<sup>11</sup> Rajamani et al., *supra* note 6.

<sup>12</sup> Niklas Höhne, Michel den Elzen & Donovan Escalante, *Regional GHG reduction targets based on effort sharing: a comparison of studies*, 14 CLIM. POLICY 122–147 (2014), <http://www.tandfonline.com/doi/abs/10.1080/14693062.2014.849452> (last visited Jan 4, 2022).

<sup>13</sup> Yann Robiou Du Pont et al., *Equitable mitigation to achieve the Paris Agreement goals*, 7 NAT. CLIM. CHANG. 38–43 (2017); Nicole J. van den Berg et al., *Implications of various effort-sharing approaches for national carbon budgets and emission pathways*, 162 CLIM. CHANGE 1805–1822 (2020), <https://doi.org/10.1007/s10584-019-02368-y> (last visited Jul 1, 2021); Christian Holz, Sivan Kartha & Tom Athanasiou, *Fairly sharing 1.5: national fair shares of a 1.5 °C-compliant global mitigation effort*, INT. ENVIRON. AGREEMENTS POLIT. LAW ECON. (2017), <http://link.springer.com/10.1007/s10784-017-9371-z>.

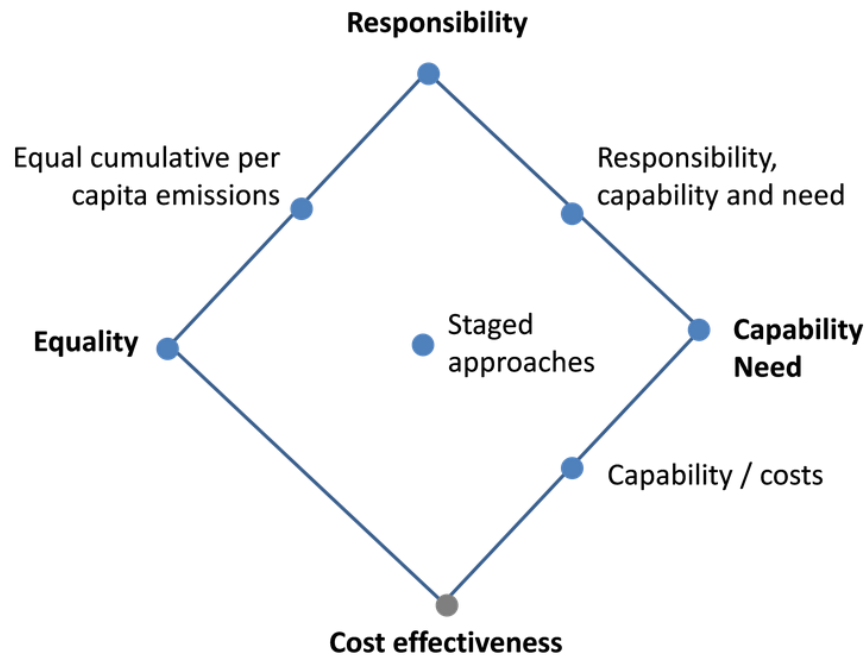


Figure 1 | Categories of equity approaches from Höhne et al., (2014)<sup>14</sup> that are applied in the Climate Action Tracker.

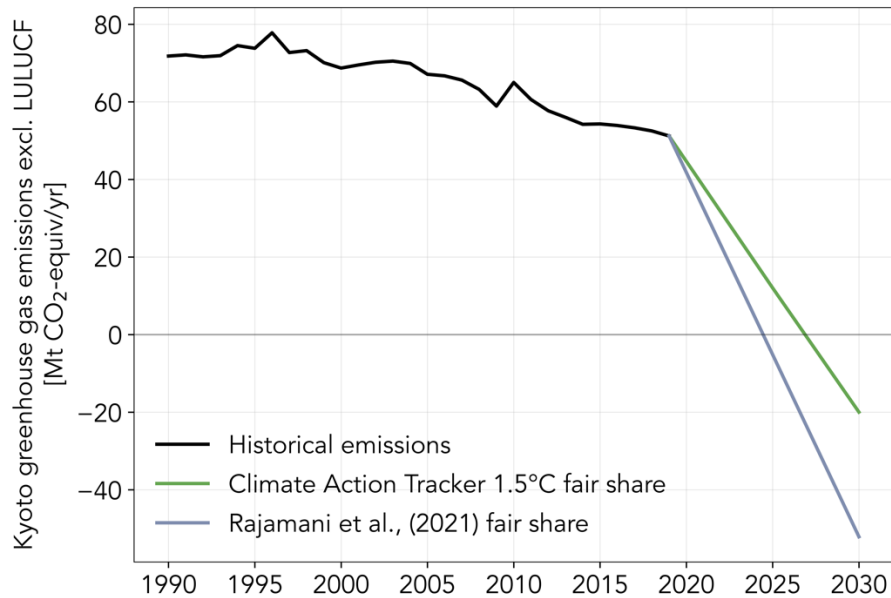
## Sweden's fair share contribution until 2030

In **Figure 1**, based on the two frameworks identified above, we present the fair share emissions allocation pathways for Sweden until 2030, based on the approaches identified above, that would be consistent with a fair contribution to a global pathway consistent with the “low overshoot” 1.5°C category introduced in an earlier section. Note that we present results for the Kyoto basket of greenhouse gases<sup>15</sup> aggregated using global warming potential 100 (GWP100) based on the IPCC’s 4<sup>th</sup> Assessment Report<sup>16</sup> in **Figure 1** and **Table 1**.

<sup>14</sup> Niklas Höhne, Michel den Elzen & Donovan Escalante, *Regional GHG reduction targets based on effort sharing: a comparison of studies*, 14 CLIM. POLICY 122–147 (2014), <http://dx.doi.org/10.1080/14693062.2014.849452>.

<sup>15</sup> The Kyoto basket of greenhouse gases includes CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O, and fluorinated gases (F-gases)

<sup>16</sup> IPCC, *Fourth Assessment Report — IPCC* (2007), <https://www.ipcc.ch/assessment-report/ar4/> (last visited Jun 16, 2021).



**Figure 2 | Fair share emissions allocation pathways for Sweden until 2030.** The historical data is the country-reported emission data from the PRIMAP-hist dataset<sup>17</sup>.

It is important to state up front that these pathways do not show what is technically and economically feasible for Sweden to achieve domestically. They rather show what emissions reductions need to be achieved as a result of action by Sweden, including both within Sweden, through the highest possible domestic ambition, and through the use of international finance and other support for emissions reductions abroad (see next section).

From the Climate Action Tracker equity framework, a fair contribution from Sweden to achieve the long-term temperature goal of the Paris Agreement would be equivalent to an average yearly reduction of emissions of 13% per year until the achievement of net zero greenhouse gas emissions (excluding LULUCF) before 2027, and further achieving an emission level of -20 Mt CO<sub>2</sub>e by 2030 (**Figure 2; Table 1**).

Based on the results from the study by Rajamani et al. (2021)<sup>18</sup>, a fair contribution from Sweden to achieve the long-term temperature goal of the Paris Agreement would be equivalent to an average yearly reduction of emissions of 18% until the achievement of net zero greenhouse gas emissions (excluding LULUCF) between 2024 and 2025, and further achieving an emission level of -52.2 Mt CO<sub>2</sub>e by 2030 (**Figure 1; Table 1**).

<sup>17</sup> Johannes Gütschow, Annika Günther & Mika Pflüger, *The PRIMAP-hist national historical emissions time series (1750-2019) v2.3.1* (2021), <https://zenodo.org/record/5494497> (last visited Dec 10, 2021); JOHANNES GÜTSCHOW ET AL., *The PRIMAP-hist national historical emissions time series*, 8 EARTH SYSTEM SCIENCE DATA (2016).

<sup>18</sup> Rajamani et al., *supra* note 6.

Fair share emission allocations for Sweden [Mt CO <sub>2</sub> e / yr] <sup>19</sup>	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	Average yearly reduction under 2019 levels [%/year] <sup>20</sup>	Absolute reduction per year under 2019 levels [Mt CO <sub>2</sub> e / yr]
CAT 1.5°C pathway	51.2	44.7	38.2	31.7	25.2	18.7	12.2	5.7	-0.8	-7.3	-13.8	-20.3	13%	6.5
Rajamani et al. 1.5°C pathway	51.2	41.8	32.4	23.0	13.6	4.2	-5.2	-14.6	-24.0	-33.4	-42.8	-52.2	18%	9.4

**Table 1** Fair share emission allocation pathways for Sweden based on the Climate Action Tracker and the study by Rajamani et al.<sup>21</sup>

## A note on interpreting the fair share results

As is clear from the results presented above, the rates of reduction and the resulting net negative emissions until 2030 are beyond any known assessment of technical and economic feasibility. Following a common understanding from the equity literature, this implies a “dual obligation”<sup>22</sup> for a developed country like Sweden – to set an **ambitious domestic emission reduction target** as well as provide **adequate support for mitigation in developing countries**, to close the gap in emission equivalent terms between the domestic emission reduction target and the fair share target.

Our assessment of a domestic 1.5°C compatible pathway for Sweden, based on global least-cost modelled pathways that are downscaled to the national level, shows that a reduction in emissions excluding LULUCF of 62% (56-69%) below 1990 levels by 2030 could be technically and economically feasible.<sup>23</sup> For example, if Sweden were to reduce emissions to 27,2 (21,9-31,4) MtCO<sub>2</sub>e by 2030 (**Table 2**), or, a reduction of around 4,3% annually from 2019 levels<sup>24</sup> (this would be a techno-economically feasible 1.5°C compatible reduction based on the report cited above), then, to achieve its fair share, Sweden would need to provide support abroad to achieve emission reductions of 47.4 Mt CO<sub>2</sub>e to achieve the CAT 1.5°C fairness benchmark.

A different assessment of 1.5°C compatible pathways for Sweden, based on two ambitious pathways, suggest a reduction in emissions excluding LULUCF of 72-78% below 1990 levels by 2030<sup>25</sup>, equivalent to a 6.0-6.3% yearly reduction under 2019 levels (Table 2 presents average yearly emissions).

<sup>19</sup> For the CAT pathway, we linearly interpolate values between 2019 and 2025, and then from 2025 to 2030.

For the Rajamani et al. pathway, we linearly interpolate values between 2019 and 2030.

<sup>20</sup> Note that we calculate this value until the last year when the fair share estimates are positive. All values are %/year reduction from 2019 emission levels.

<sup>21</sup> Rajamani et al., *supra* note 6.

<sup>22</sup> Christian Holz, S Kartha & T Athanasiou, *Fairly sharing 1.5: national fair shares of a 1.5 °C-compliant global mitigation effort*, 18 INT. ENVIRON. AGREEMENTS POLIT. LAW ECON. 117–134 (2018), <https://www.semanticscholar.org/paper/c3b3117b46f1b68a56e7e76806175a5d3c591f61>.

<sup>23</sup> Climate Analytics, 2022. An assessment of the adequacy of the mitigation measures and targets of the respondent states in Duarte Agostinho vs Portugal and 32 other states. <https://climateanalytics.org/publications/2022/an-assessment-of-the-adequacy-of-the-mitigation-measures-and-targets-of-the-respondent-states-in-duarte-agostinho-v-portugal-and-32-other-states/>

<sup>24</sup> *ibid*

<sup>25</sup> Climate Analytics, 2021. 1.5°C Pathways for Europe: Achieving the highest plausible climate ambition. [https://climateanalytics.org/media/1-5pathwaysforeurope\\_2.pdf](https://climateanalytics.org/media/1-5pathwaysforeurope_2.pdf)

According to this assessment, if Sweden were to reduce emissions to 17,8 (16,1-19,6) MtCO<sub>2</sub>e by 2030 (**Table 2**), then, to achieve its fair share, Sweden would need to provide support abroad to achieve emission reductions of 38.1 Mt CO<sub>2</sub>e to achieve the CAT 1.5°C fairness benchmark.

Domestic 1.5 compatible emission allocations for Sweden [Mt CO <sub>2</sub> e / yr]	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	Absolute yearly reduction average [Mt CO <sub>2</sub> e / yr]
Duarte Agostinho vs Portugal et al <sup>26</sup>	51.2	50.2	47.9	45.7	43.4	41.2	38.9	36.6	34.2	31.9	29.5	27.2	2.2
1.5 Pathways for Europe	51.2	49.3	46.7	44.2	41.7	39.1	36.6	32.8	29.1	25.3	21.6	17.8	3.1

**Table 2** Domestic 1.5 compatible emission allocation pathways for Sweden

It is important to bear in mind that our calculations use Sweden’s 2019 emissions as the latest data available at the time of analysis. The emissions reductions pathway required as of 2022 is even more stringent than the pathway presented in this report because Sweden’s emissions have not fallen quickly enough since 2019. For example, Sweden’s GHG emissions for 2021 were 48.7 Mt CO<sub>2</sub>e<sup>27</sup>, which is 0.8 or 2 Mt CO<sub>2</sub>e higher than its allocation for the same year under our domestic 1.5 compatible pathways shown in **Table 2**. This means that the excess emissions up to 2022 will have to be compensated with more stringent yearly reductions to reach the emission levels indicated in the pathways by 2030 (**Table 2**). This consideration also applies to the fair-share pathways presented in **Table 1**.

<sup>26</sup> For the domestic pathway, we linearly interpolate values between 2020-2025 and 2025-2030.

<sup>27</sup> Statistics Sweden, 2022. Greenhouse gas emissions from Sweden’s economy increased in 2021.

<https://www.scb.se/en/finding-statistics/statistics-by-subject-area/environment/environmental-accounts-and-sustainable-development/system-of-environmental-and-economic-accounts/pong/statistical-news/environmental-accounts---emissions-to-air-q4-2021/>