Equitable emissions reductions under the Paris Agreement

Climate Action Tracker

Paola Parra, Uğur Ural, Jasmin Cantzler, Bill Hare
Climate Analytics

Hanna Fekete, Lisa Luna, Niklas Höhne
NewClimate Institute

Yvonne Deng, Kornelis Blok
Ecofys

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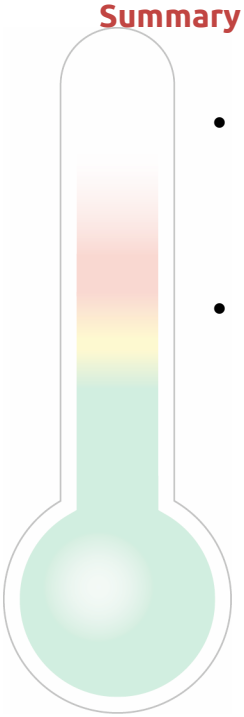
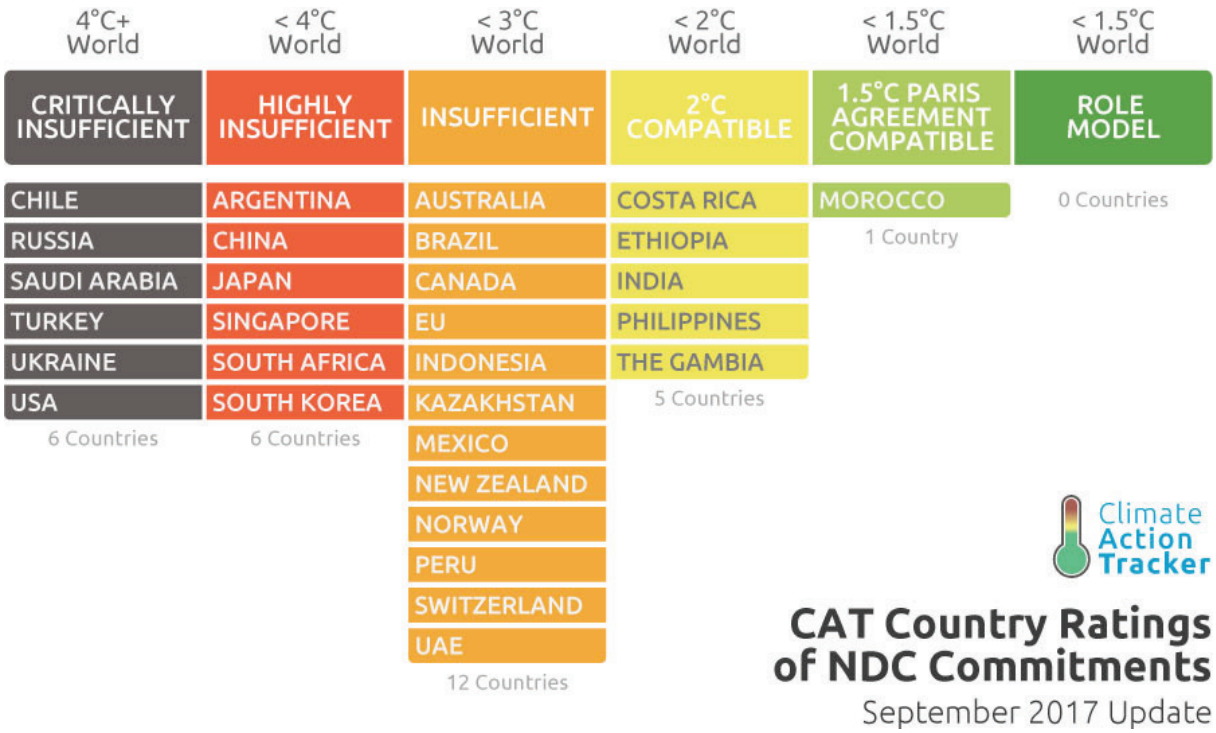
Summary



- The Climate Action Tracker (CAT) has updated its effort sharing methodology to reflect the increase of climate mitigation required to meet the Paris Agreement 1.5˚C long-term temperature limit, and the most recent literature published about equitable emissions reductions and the most recent emissions trends.[1]
- The updated CAT rating system has six categories: "**Role model,**" "**1.5˚C Paris Agreement-compatible**," "**2˚C compatible**," "**Insufficient**," "**Highly insufficient**," and "**Critically insufficient**:"
    - We have now divided our "S**ufficient**" category into two: "**1.5˚C Paris Agreement-compatible** "and "**2˚C compatible**." The "2˚C compatible" category refers to the 2˚C goal adopted in Copenhagen in 2009, now replaced by the 1.5˚C limit in the Paris Agreement. This provides an historical reference point and bridge to the Paris Agreement-compatible category rating.
    - We have renamed the **"Medium"** category **"Insufficient"** because countries rated "medium" would still require others to take considerably more action to keep warming below 2˚C, let alone limit it to 1.5˚C as required under the Paris Agreement.
    - Similarly, so many countries fell into the **"Inadequate"** category that it was difficult to differentiate between their levels of (insufficient) action. We have therefore divided the **"Inadequate"** category into two: **"Highly insufficient**," (Japan, South Africa), and **"Critically insufficient"**—reserved for those taking the very least amount of action, such as the US, Russia and Saudi Arabia.

[1] see Background for further explanation of the methodology.

- Our new rating is as follows:



- We find that the main implication of including 1.5°C Paris Agreement-compatible scenarios in fair-share mitigation ranges is that, for many countries, the "Role model" category now requires increased mitigation efforts, as would be expected for moving to a more ambitious target.
- The overall impact of including the most recently-available data varies from country to country. For most countries, the effect of updated allowances in the Fair Share range did not lead to a change in the country's actual rating.

Introduction

The central objective of the Paris Agreement is its long-term temperature goal to hold global average temperature increase to "well below 2°C above preindustrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels," which goes significantly further, both legally and substantively, than the earlier goal to hold warming to below 2°C (Schleussner et al. 2016).

In their Nationally Determined Contributions (NDCs), governments put forward their mitigation commitments to achieve this global goal. The Climate Action Tracker (CAT) has been rating governments' mitigation targets against their "fair shares" since 2009.

The CAT has updated its effort sharing methodology to reflect the increase of required mitigation action implied by the Paris Agreement's long-term temperature limit, as well as the most recent literature published about equitable emissions reductions.

The Paris Agreement stipulates that NDCs should reflect the "highest possible ambition" and "common but differentiated responsibilities and respective capabilities, in the light of different national circumstances" (Paris Agreement, Article 4.3). However, there are no rules in place for what the ambition level of the contribution should be based on. Assessing what is *fair* depends on the viewpoint. Some consider it fair that those who have made a bigger contribution to the problem, or have a higher capability to act, do more. But even if governments agreed on such a principle, this would have to be quantified to find out how much each country should do.

The CAT gives a transparent way of comparing mitigation targets and proposals with the many interpretations of what is fair. Our rating system evaluates the adequacy of emissions levels resulting from emissions reduction pledges and current policy projections against effort-sharing benchmarks for each country.

Since 2009, the CAT has continuously enhanced the rating method and coverage of data. This update evaluates whether targets' emissions levels are compatible with the more ambitious Paris Agreement long-term temperature limit and reflects the most recent literature published about equitable emissions reductions and the most recent emission trends.

Background – the CAT rating methodology

In our assessment, we have compiled a wide range of literature on what different researchers from many perspectives would consider a "fair" contribution to greenhouse gas reductions. The "effort-sharing" studies in the CAT's database include over 40 studies used by the IPCC (chapter 6 of WG III (IPCC, 2014) and Höhne et al. (2014)) plus additional analyses the CAT has performed to complete the data.

Instead of deciding on an approach to determine what is fair, we construct a Fair Share range of emissions allowances for each country from the range of estimates in the literature, covering as many different approaches as possible.

For each country and year, we show the emissions ranges that result from approaches grouped in seven specific effort-sharing categories: responsibility, capability, equality, equal cumulative emissions per capita, responsibility/capability/need, capability/cost, and staged. The spread of results across all these categories in the underlying studies defines our fair share range.

We then divide the Fair Share range of each country into three different rating categories, based on temperature levels that would result from all countries choosing this level of effort. We also assign rating categories to the emissions levels below and above the Fair Share range in order to rate commitments that fall outside the country's Fair Share range.

For further methodological details on the CAT rating methodology refer to our methodology page.

CAT rating system update

The pre-2017 CAT rating methodology rated countries using four categories: "role model", "sufficient," "medium" and "inadequate." For our 2017 update, we have decided to further disaggregate the rating categories to better differentiate levels of ambition, and provide a closer link to the former global temperature goal and the Paris Agreement temperature limit.

Table 1 summarises the differences between the old and new rating categories. The temperature level reflects global temperature increase above preindustrial levels, if all countries were to adopt a target that falls into this rating category.

Table 1: Comparison of old and new rating categories

	OLD RATING	NEW RATING	
UPPER END	Inadequate	Critically Insufficient	Commitments with this rating fall well outside the fair share range and are not at all consistent with holding warming to below 2°C let alone with the Paris Agreement's stronger 1.5°C limit. If all government targets were in this range, warming would exceed 4°C.
		Highly Insufficient	Commitments with this rating fall outside the fair share range and are not at all consistent with holding warming to below 2°C let alone with the Paris Agreement's stronger 1.5°C limit. If all government targets were in this range, warming would reach between 3°C and 4°C.
FAIR SHARE RANGE	Medium	Insufficient	Commitments with this rating are in the least stringent part of their fair share range and not consistent with holding warming below 2°C let alone with the Paris Agreement's stronger 1.5°C limit. If all government targets were in this range, warming would reach over 2°C and up to 3°C.
	Sufficent	2°C Compatible	Commitments with this rating are consistent with the 2009 Copenhagen 2°C goal and therefore fall within the country's fair share range, but are not fully consistent with the Paris Agreement. If all government targets were in this range, warming could be held below, but not well below, 2°C and still be too high to be consistent with the Paris Agreement 1.5°C limit.
		1.5°C Paris Agreement Compatible	This rating indicates that a government's efforts are in the most stringent part of its fair share range: it is consistent with the Paris Agreement's 1.5°C limit.
LOWER END	Role Model	Role Model	This rating indicates that a government's efforts are more ambitious than what is considered a fair contribution: it is more than consistent with the Paris Agreement's 1.5°C limit.

Beyond the changes in the rating categories, we have updated our effort sharing methodology to reflect the increase in climate mitigation action implied by the Paris Agreement's long-term temperature limit, as well as the most recent literature published about equitable emissions reductions.

Figure 1 summarises the main changes introduced in the 2017 methodology update and illustrates the potential impacts of those changes in countries' Fair Share ranges and ratings, which are explained in more detail below.

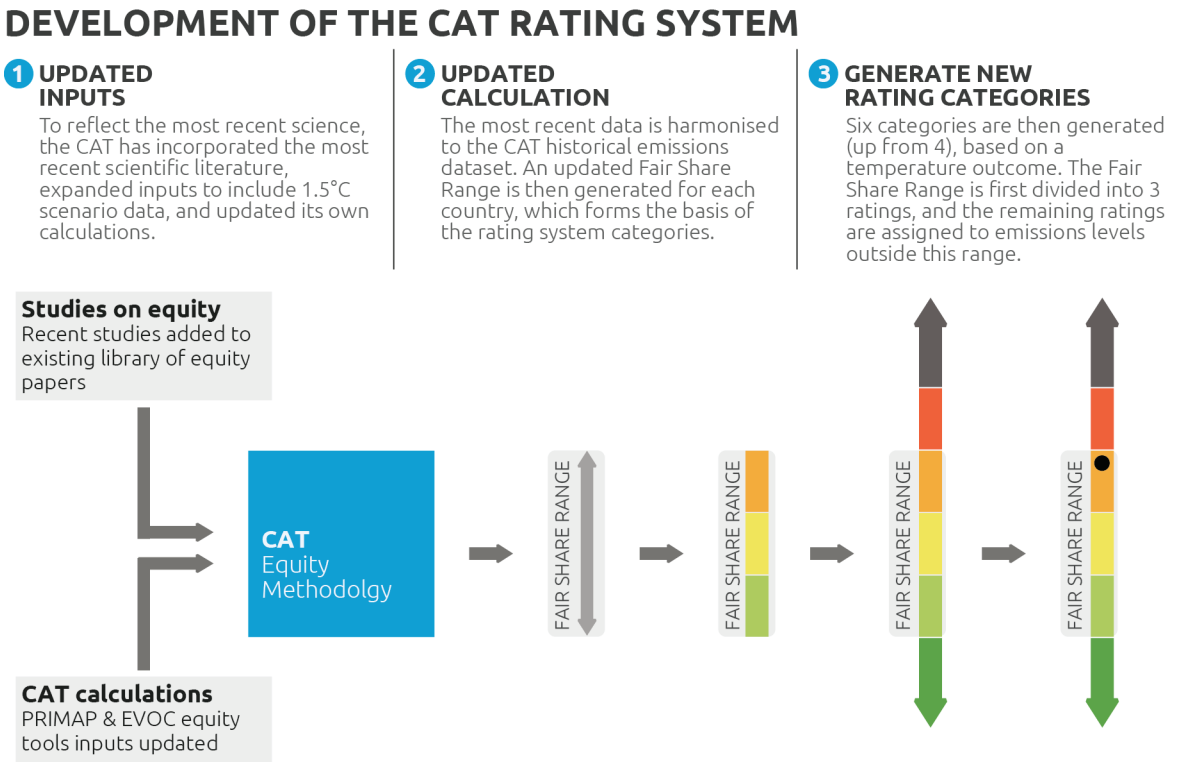


Figure 1 - CAT equity methodology update

Country results

As shown in Figure 1, the 2017 Fair Share ranges of the CAT countries include a significantly higher amount of data both from new literature published in recent years and allowances compatible with 1.5°C scenarios across all effort sharing categories. To be able to compare allowances from different studies, the CAT harmonises the results of the studies to the most recently available historical emissions data, which has also been updated in a number of countries.

Together, these changes can create shifts in the Fair Share range of each CAT country compared to the 2016 methodology. The shifts can be classified in three general groups: the range shrinks at both ends, the range expands at both ends, and the range moves (up)downwards.

In the first group, the upper end of the Fair Share range decreases while the lower end increases, causing the range to shrink. This demonstrates more convergence across studies and categories than in the previous results. This group includes Costa Rica and Chile.

On the contrary, for countries in the second group the upper end of the Fair Share range increases while the lower end decreases, showing less convergence across studies and categories than in previous results. For these countries, often the 1.5°C compatible allowances differ substantially from the 2°C compatible ones, making the overall spectrum of fair emissions levels much broader than before. This group includes India, Indonesia, and Argentina.

Finally, when both the upper and lower end of the Fair Share range move in the same direction, the ranges shift completely downward or upward (e.g. for Australia, New Zealand, Nepal). While the magnitude in the shift and the reasons behind it are country and category specific, in general such shifts reflect changes in the relative positions of countries in various effort-sharing indicators, such as the capability to mitigate or historical responsibility.

A more detailed explanation of the impacts of each of the updates introduced in the 2017 methodology in countries' Fair Share ranges, as well as specific country examples, can be found in Annex 2 and 3 of this briefing.

The combined effect of all changes in the 2017 methodology update has resulted in changes and shifts in the Fair Share ranges of all the 33 countries the Climate Action Tracker assesses, compared to the 2016 Fair Share ranges.

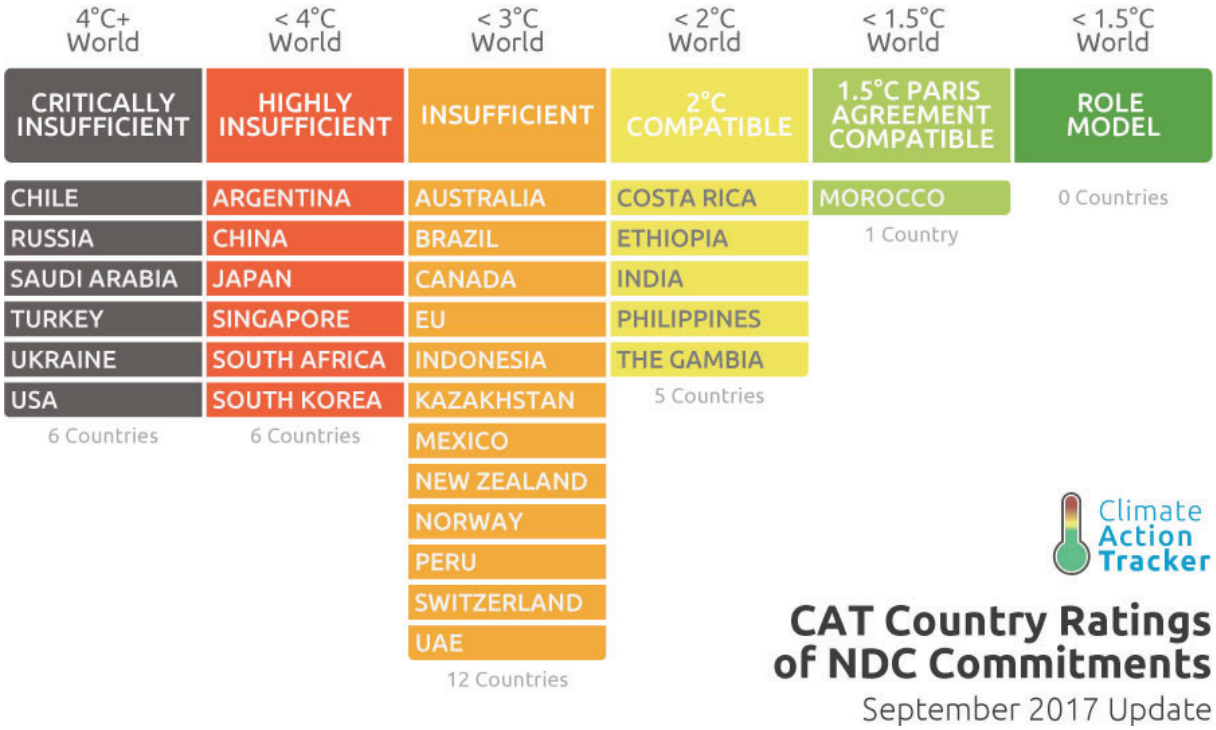


Figure 2 - CAT Rating of countries NDCs with updated method

The rating category changed for 8 out of 33 countries due to updated data. For the rest of the countries, target emissions levels fall into the same area of their Fair Share range, despite the shift in this range. For those countries, the change in rating then results from our new rating scheme (explained in Table 1). Annex 1 includes a full overview of the rating changes for all CAT countries, compared to the 2016 methodology. In annex 2 and 3, we explain in more detail the impacts of each of the changes to the Fair Share ranges introduced in the 2017 methodology.

Annex 1 – Summary changes rating 2016-2017

COUNTRIES WITH ONLY NEW RATING NAME

	OLD RATING		NEW RATING
Morocco	Sufficient	→	1.5°C Paris Agreement Compatible
Costa Rica	Sufficient	→	2°C Compatible
Ethiopia	Sufficient	→	2°C Compatible
The Gambia	Sufficient	→	2°C Compatible
Brazil	Medium	→	Insufficient
European Union	Medium	→	Insufficient
Indonesia	Medium	→	Insufficient
Kazakhstan	Medium	→	Insufficient
Mexico	Medium	→	Insufficient
Norway	Medium	→	Insufficient
Peru	Medium	→	Insufficient
Switzerland	Medium	→	Insufficient
Argentina	Inadequate	→	Highly Insufficient
Japan	Inadequate	→	Highly Insufficient
Singapore	Inadequate	→	Highly Insufficient
South Africa	Inadequate	→	Highly Insufficient
South Korea	Inadequate	→	Highly Insufficient

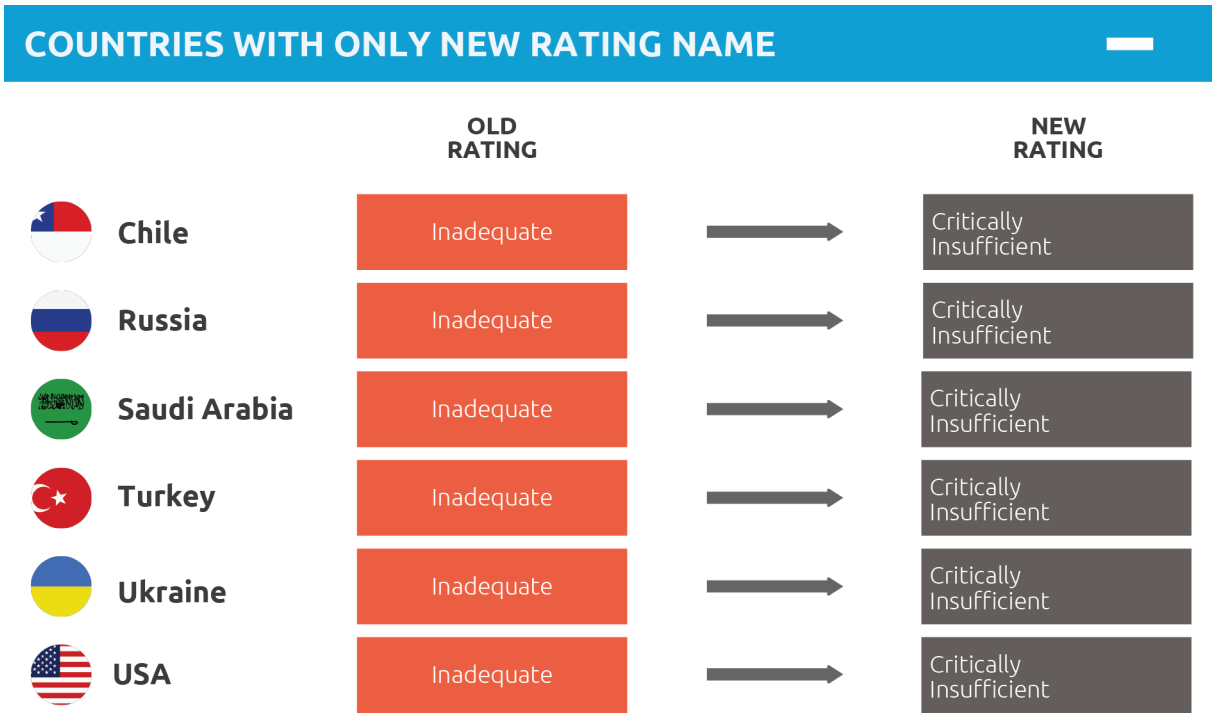


Figure 3 – Countries with a change in rating which is only due to the split of the previous four categories into six categories (see Table 1).

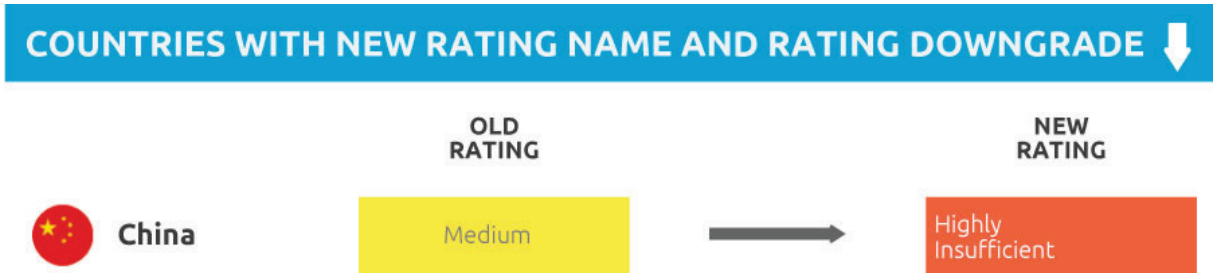


Figure 4 – Countries with a downgrade in rating.

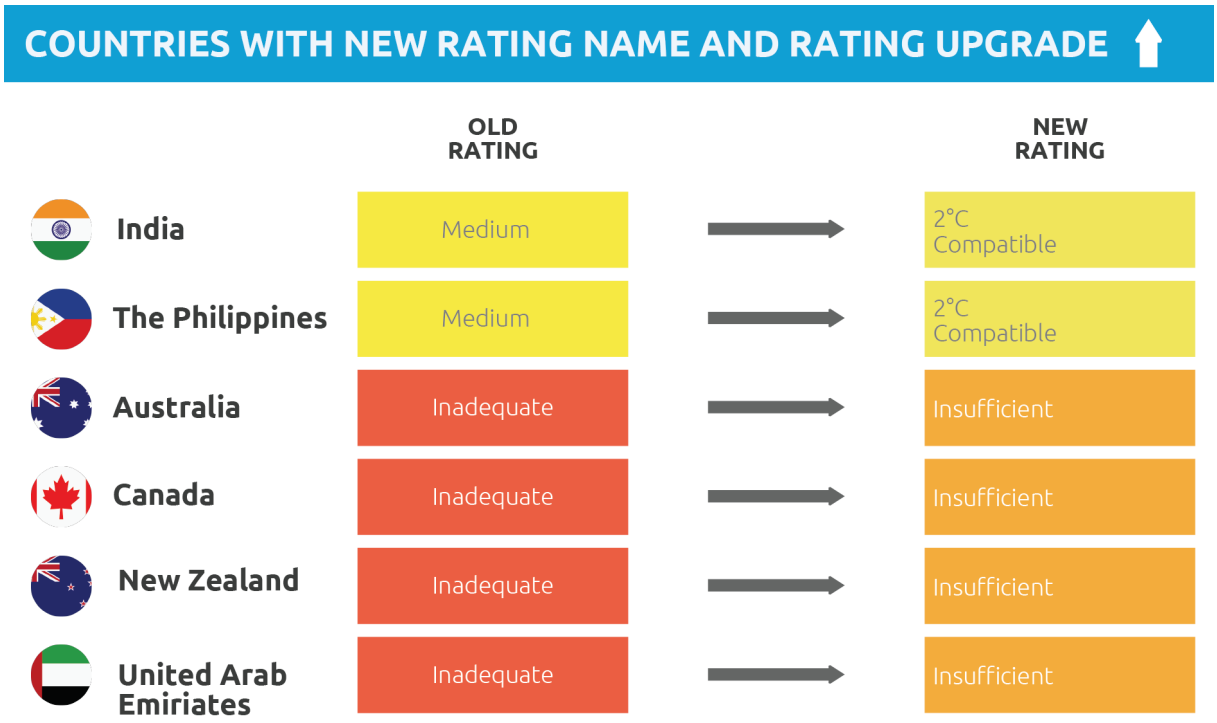


Figure 5 – Countries with an upgrade in rating.

Annex 2 – Implications of including the 1.5°C Paris Agreement-compatible scenarios in fair-share mitigation ranges

The Paris Agreement's central objective is its long-term temperature goal - to hold global average temperature increase to "well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels". There are currently two interpretations of the implications of this new, more stringent temperature goal:

1. Warming might exceed the 1.5°C level by a small amount while remaining "well below 2°C" and returning to 1.5°C.
2. A different interpretation, held by the most vulnerable countries, is that the Paris Agreement warming should not exceed 1.5°C.

Since its inception in 2009, the Climate Action Tracker has consistently referred to the 1.5°C global mean warming limit in its analyses, alongside the 2°C pathway. We do this to compare the global effect of commitments - and commitments with emission pathways - for both of these warming limits. The 2oC pathways refer to the former 2°C goal adopted in 2009, now replaced by the 1.5 □C limit in the Paris Agreement,

However, given the lack of scenarios with appropriate resolution for 1.5°C pathways, the CAT rating system, until now, has drawn mainly from the published 2°C pathways and related equity and fairness studies. For our 2017 update, to reflect the additional efforts required under the Paris Agreement temperature goal, the Climate Action Tracker has updated its methodology, particularly its rating system, by including 1.5°C-compatible scenarios in the Fair Share range of countries.

To better understand the implications of including 1.5°C-compatible emissions allowances in the Fair Share range of each country (putting aside other updates introduced in the 2017 methodology update) we have compared the allowances of 2°C-compatible scenarios with those compatible with 1.5°C.

Overall, the lower end of emissions allowances (more stringent end of the Fair Share range) under the 1.5°C compatible scenarios tends to be lower, sometimes significantly lower, than the lower end of 2°C compatible scenarios for most countries as would be expected.[2]

As shown in Figure 6, for 2030, which is the year where we rate most of the NDCs, we find that the lower end of emissions allowances of 1.5°C compatible scenarios is 10% or more lower than 2°C compatible scenarios for 2030 for the majority of countries. We also find that this difference between 1.5°C and 2°C scenarios increases substantially as time progresses: in 2050, 1.5°C compatible scenarios are at least 25% lower than 2°C compatible scenarios for all countries with the exception of Switzerland and Indonesia. **The main implication is that, for many countries, the "role model" category becomes more difficult to achieve, as would be expected for moving to a more ambitious target.**

However, the implications of including 1.5°C-compatible scenarios is more ambiguous for the upper end of emissions allowances (less stringent end of the Fair Share range), where we found that 1.5°C compatible scenarios are not always lower than 2°C compatible scenarios for every country: In 2030, the upper end of 1.5°C-compatible scenarios is lower than the 2°C compatible scenarios for only 18 out of 33 countries.

[2] Although for most (24) of the assessed countries 1.5°C scenarios have emissions levels which are at least 10% lower than 2°C scenarios, for other countries (India, Gabon, Ethiopia, Singapore) the difference is less than 10%. For yet others there are deviations in the other direction: for instance for Bhutan, Canada and China the lower end 1.5 °C scenario emission levels is slightly higher than 2°C scenario emission levels; and for the Philippines this lower end is considerably higher than for the 2°C scenarios.

The apparently unintuitive result for allowances until 2030 can be explained by the diversity of underlying studies and the fact that most studies only assess either 2°C or 1.5°C, but not both, and therefore inconsistencies can occur when comparing these two groups of studies. However, by 2050, the upper effort sharing boundary for 1.5°C scenarios is lower for all countries, except for Brazil and Indonesia.

Figure 6 summarises the comparison of the upper and lower end of emissions allowances under 1.5°C and 2°C scenarios for the 33 countries assessed by the CAT.

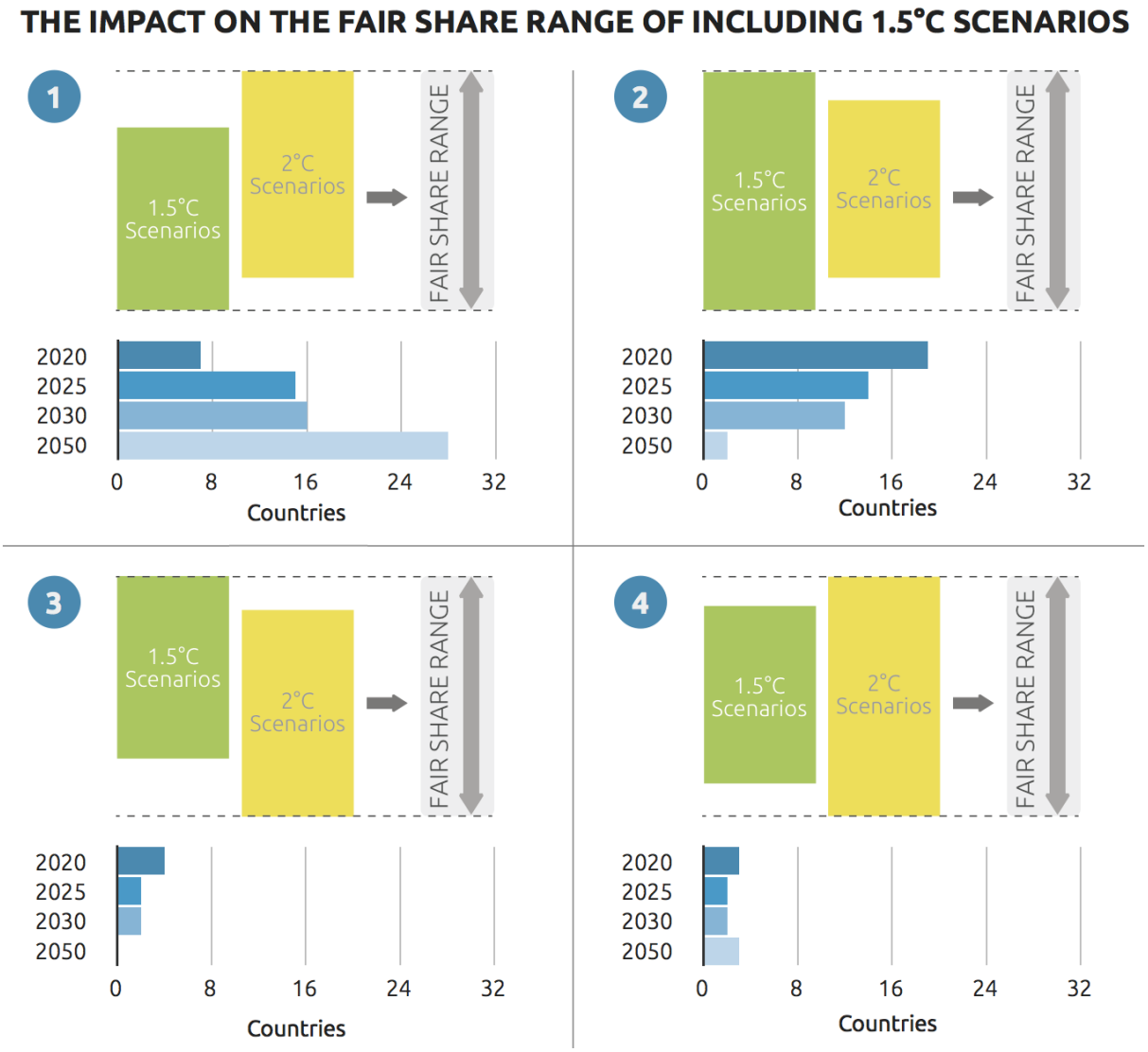


Figure 6 - Comparison ranges of emissions allowances under 1.5°C and 2°C scenarios for the 33 CAT countries. Each of the four cases illustrated results from different combinations of the relative positions of the upper and lower end of the emissions allowances ranges under 1.5°C and 2°C compatible scenarios. The bar graph below each case shows the number of CAT countries for which each case applies in each of the target years (e.g. in 2030 for 16 CAT countries the lower and upper end of the 1.5°C compatible allowances are lower than the ones for 2°C scenarios).

Annex 3 – Implications of including the most recent data available

As time progresses, national and global emissions change. For example, the global 2°C and 1.5°C consistent levels in a particular year in the future will change, due to recalculations of the carbon budget already used. This can lead to changes in the rating for specific countries, even when the same global ambition level and the same equity approach is used. In addition, ratings can change due to changes in data availability, with, e.g., more recent emissions data becoming available for some countries, but not all of them.

The input of most studies included in our effort sharing range cannot be updated to reflect recent developments in country-level data, as the authors have not published updated versions of their allowances estimates. However, the CAT methodology includes a harmonisation of the input data of each study's base year to the most recently-available historical emissions data. Changes in historical emissions data thus result in changes in the emissions allowances allocated to each country. See our methodology page for further details on our harmonisation approach.

A large number of effort sharing assessments included in our Fair Share ranges come from the PRIMAP Equity tool of Climate Analytics. These assessments have been updated in 2017 to reflect the most recently available socioeconomic and country emissions data. Specifically, allowances are now calculated using socioeconomic indicators from 2014 instead of 2010. In addition, the PRIMAP Equity tool now includes the most up-to-date emissions scenarios from the Fifth Assessment Report (AR5) of the Intergovernmental Panel on Climate Change (IPCC) for the calculation of the global mitigation burden.[3] Both changes in the CA-PRIMAP Equity tool result in different country emissions allowances compared to the previous version of the database (2015).

The changes mentioned above mean the updated data for the Fair Share ranges reflect recent developments in emissions that our previous assessments did not capture, and allow for a better understanding of future emissions allocations for the countries assessed by the CAT.

In addition, for the 2017 methodology update, the CAT has included a number of recently-published peer-reviewed papers. Table 2 summarises the new studies included.

Table 2. New studies included in 2017 methodology update.

Reference Study	Effort-sharing categories covered	Countries covered
(Winkler et al., 2013)	• Responsibility, capability and need	All CAT countries except EU28
(Edenhofer et al., 2010)	• Equality	China, EU28, India, Japan, Russia and USA
(Pan et al., 2014)	• Equality • Staged	All CAT countries except EU28
(Robiou du Pont et al., 2016)	• Capability • Equal cumulative per capita emissions • Equality • Responsibility, capability, and need	All CAT countries except United Arab Emirates

[3] The global mitigation burden is defined as the distance between the Business as Usual scenario (in this case RCP8.5) and the target emissions pathway (no-delay action AR5 scenarios for 2°C and 1.5°C). The scenarios used for the calculation of the mitigation burden correspond to Shared Socioeconomic Pathway 2 (SSP2) scenarios from the REMIND-MAGPIE model of the Potsdam Institute for Climate Impact Research (PIK). SSP2 pathways make "middle of the road" socioeconomic projections that follow the trends, with some progress towards achieving development goals and reductions in resource and energy intensity at historical rates.

	• Staged	

The overall impact of including the most recently available data in the effort sharing ranges is category and country specific, and varies in extent. While for most of the countries the effect of updated allowances in the Fair Share range was moderate, there were some for which the inclusion of updated data resulted in changes big enough to cause a substantial shift in that country's Fair Share range and resulted in a change to its rating. Here, we describe in more detail the changes for countries with a substantial Fair Share shift:

India and Philippines: for these two countries, the new studies included have more extreme emissions allowances for both the higher and lower ends for the Fair Share ranges, which results in an overall bigger Fair Share range and, ultimately, in a rating upgrade. One new study reflecting 1.5°C scenarios (Pan et al., 2014) includes effort sharing approaches, which allocate the higher emissions allowances to these two countries than the studies using 2°C scenarios. Therefore, there is an upwards shift in the upper end of the Fair Share ranges.

China: this is an example of the changes in emissions allowances coming from the CA-PRIMAP Equity tool. Given the stark increase in annual and cumulative emissions that China experienced between 2010 and 2014, as well as the improvement in socioeconomic indicators such as GDP and Human Development Index (HDI), emissions allowances resulting from the updated tool are consistently more stringent for China under most categories, as would be expected given the country's higher historical responsibility and capability to mitigate. As a consequence of the overall lower emissions allowances, China's NDC now falls outside its Fair Share range.

Australia, Canada and New Zealand: for these three countries, the main differences in the allowances result from three specific categories: "Capability", "Responsibility/Capability/Need" and "Staged"—approaches that combine responsibility and capability. The higher emissions allowances in these categories correspond to both the (Robiou du Pont et al., 2016) study included recently and the updated CA-PRIMAP Equity tool.

Changes in allowances for these three countries in the CA-PRIMAP Equity tool can be explained by the change in the relative position of the countries in the global responsibility and capability rankings. Higher allowances for some wealthy countries reflect one general characteristic of effort-sharing approaches: given that the global distribution of allowances is a zero-sum game, more stringent emissions allowances for one country (resulting, for instance, from higher capability) result in higher emissions allowances for other countries.

References

Edenhofer, O., Knopf, B., Barker, T., Baumstark, L., Bellevrat, E., Chateau, B., Criqui, P., Isaac, M., Kitous, A., Kypreos, S., Leimbach, M., Lessmann, K., Magn??, B., Scrieciu, ??erban, Turton, H., Van Vuuren, D.P., 2010. The economics of low stabilization: Model comparison of mitigation strategies and costs. Energy J. 31, 11–48. doi:10.5547/ISSN0195-6574-EJ-Vol31-NoSI-2

Höhne, N., den Elzen, M., Escalante, D., 2014. Regional GHG reduction targets based on effort sharing: a comparison of studies. Clim. Policy 14, 122–147. doi:10.1080/14693062.2014.849452

IPCC, 2014. Climate Change 2014: Mitigation of Climate Change, Working Group III Contribution to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. doi:10.1017/CBO9781107415416

Pan, X., Teng, F., Wang, G., 2014. Equitable access to sustainable development based on the comparative study of carbon emission rights allocation, Applied Energy.

Robiou du Pont, Y., Jeffery, M.L., Gütschow, J., Rogelj, J., Christoff, P., Meinshausen, M., 2016. Equitable mitigation to achieve the Paris Agreement goals. Nat. Clim. Chang. 7, 38–43. doi:10.1038/nclimate3186

Winkler, H., Letete, T., Marquard, A., 2013. Equitable access to sustainable development: operationalizing key criteria. Clim. Policy 13, 411–432. doi:10.1080/14693062.2013.777610

The Climate Action Tracker is an independent science-based assessment that tracks the emission commitments and actions of countries. It is a joint project of the following organisations:

Climate Analytics

Climate Analytics is a non-profit institute based in Berlin, Germany, with offices in Lomé, Togo and New York, USA, that brings together inter-disciplinary expertise in the scientific and policy aspects of climate change with the vision of supporting science-based policy to prevent dangerous climate change, enabling sustainable development. Climate Analytics aims to synthesise and advance scientific knowledge in the area of climate, and by linking scientific and policy analysis provide state-of-the-art solutions to global and national climate change policy challenges. Contact: Dr. h.c. Bill Hare, +49 160 908 62463

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