Fair contributions versus fastest possible reductions

Equity considerations in the context of the Paris Agreement and the climate emergency

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August 2020

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Project number
317022

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The contents of this report are based on research conducted in the framework of the project "Implikationen des Pariser Klimaschutzabkommens auf nationale Klimaschutzanstrengungen", conducted on behalf of the German Federal Environment Agency, FKZ 3717 41 102 0. The views expressed in this paper are strictly those of the authors and do not necessarily represent the opinion of the German Federal Environment Agency, nor of the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety.

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Summary

Five years after the adoption of the Paris Agreement, the need to reduce global greenhouse gas (GHG) emissions without further delay is more urgent than ever. Emission reduction rates never seen before are necessary to meet the long-term temperature goal of the Paris Agreement and to avoid the worst impacts from climate change.

In the longer term, all sectors and countries will need to reach GHG neutrality and in particular, mitigate all avoidable energy- and process-related GHG emissions, in order to be in line with a Paris-compatible pathway.

Given the agreement on the global challenge, the combination of equity-based assessments and domestic mitigation potential together can give guidance for exploring and setting national targets for greenhouse gas emissions that are in line with the goals of the Paris Agreement. While both methods yielded quite similar results only 10 years ago, they provide very different results today. The concept of a fair contribution applied only to domestic emissions may either stop the discussion before it started for developed countries (requiring net zero emissions within a decade) or suggesting that an increase in emissions is in line with the Paris Agreement for some developing countries for a longer period of time (while it is actually not).

To make the stringent global mitigation pathways possible, emissions in all countries have to be reduced as fast as possible. Whether a national emission pathway itself is in line with the responsibility and capability of that country becomes less relevant. It is now more a question of who pays for the transition, not where it is happening.

It is therefore fundamental that all countries explore their full mitigation potential, also considering global cost effectiveness or the “highest possible ambition“ as it is termed in the Paris Agreement. Until 2030 – most relevant for the updates of NDCs – substantial effort is needed in all sectors (energy supply, industry, buildings, transport), but speed of cost-efficient decarbonisation will be different across sectors and countries. From the sectoral evaluation, we conclude that national sector targets will be required in addition to national economy-wide targets, to avoid lock-ins in the more difficult-to-decarbonize sectors. In particular, there is a strong need for ambitious sector-specific 2030 targets, best enshrined in national law. Complementing global model results with national bottom-up scenarios can provide valuable insights about national leeway in this regard.

If the national potential is not substantial enough to represent a fair contribution (likely for most developed countries), these countries should support other countries to make the transition. If the highest possible ambition leads to faster reductions than the fair contribution (likely for many developing countries), these countries would receive financial support.

Such support should not finance the cheapest reductions in developing countries as such reductions are to be implemented by the countries themselves in order to set and meet their stringent domestic emission targets. The financial support should, in particular, help to avoid sectoral lock-ins which usually require much higher efforts compared to current NDC pathways, most of which were designed to be in line with the now outdated below-2°C limit. The difference between cost-effective 2°C and 1.5°C pathways can help identify the difficult steps that could be supported, although some caution is required in the interpretation due to uncertainties about future cost developments.

For instance, highly developed countries could support:

- In the energy supply sector: a “top up”, e.g. for each coal plant that the country replaces itself with renewables, developed countries offer to finance the replacement of an additional plant, especially when closing the plants is costly and requires significant societal change.
- In the industry sector: the switch to low- or zero-carbon industrial production processes.

- In the buildings sector: the transformation of building stocks based on the difference between globally best available technologies and a local building standard.
- In the transport sector: the development of infrastructure for low-carbon transport (electrification, public transport) that requires high upfront investments.

The support of highly developed countries to other countries to reach a 1.5°C pathway can be addressed through various instruments, e.g. international climate finance through multilateral or development banks, but also through international market mechanisms to be established under Article 6.4 of the Paris Agreement. In addition to financial support, instruments to overcome non-financial barriers, such as labour constraints, will be required. Both financial and non-financial instruments must be designed to support high-ambition activities in a coordinated manner.

Table of contents

1 Introduction

Five years after the adoption of the Paris Agreement, the need to reduce global greenhouse gas emissions without further delay is more urgent than ever (Höhne *et al.*, 2020). Emission reduction rates never seen before are necessary to meet the long-term temperature goal of the Paris Agreement and to avoid the worst impacts from climate change.

The economic and technical potentials vary per country or region, and the international community agrees that countries have different capabilities and responsibilities to mitigate climate change. As we currently face a climate emergency, we need to examine equity considerations while analysing how fast emissions can physically be reduced.

Wachsmuth et al. (2019) provides an assessment of the evolution of what can be considered a fair contribution ("equity-based emission allowances") and an indication of emission reduction opportunities, assuming that reductions should happen where they are the cheapest (cost-effective emission reduction potential) for seven large emitters (Brazil, Canada, China, India, Japan, United States, EU28), when moving from pre-Paris below-2°C mitigation pathways to 1.5°C pathways implied by the Paris Agreement. Fekete et al., (2019) takes a detailed look at the results for each of these large emitters in the context of current emission trends and targets.

This discussion paper synthesizes the results of both papers. This synthesis describes how to interpret the difference between domestic mitigation potentials and "fair" emissions reduction ranges in the context of the Paris Agreement and the urgency implied by the climate emergency. It provides recommendations related to this topic for the further development of nationally determined contributions (NDCs) and long-term strategies (LTS), both required under the Paris Agreement. The paper further zooms into 1.5°C-compatible pathways from different studies and compares sector-specific mitigation potentials.

2 Overview of concepts: Equity-based distribution vs. domestic potentials

Setting the level of national greenhouse gas emission reduction targets is at the heart of international climate negotiations under the UNFCCC and has been a matter of debate for decades. There is agreement on the global goal to avoid dangerous interference with the climate system and to limit global temperature increase to well below 2°C and make efforts to limit it to 1.5°C. However, there is no agreement on how much each individual country should contribute to meeting this objective.

The classic way to determine differentiated targets between countries is to define a global level of allowed emissions and share that level amongst countries using indicators describing common but differentiated responsibilities, for example emissions per capita or GDP per capita. These approached are often referred to as "equity-based effort sharing". Those with higher responsibility and capability have to do more and vice versa (Höhne, den Elzen and Escalante, 2014).

Ten years ago, when the world was set to halve global emissions within the following 40 years to stay within the 2°C limit, these approaches gave differentiated results that are close to what is technically feasible on the ground. Developed countries were to reduce their emissions by 25% to 40% below 1990 by 2020 and by 80 to 95% by 2050 to be compatible with the 2°C limit (Gupta *et al.*, 2007; den Elzen and Höhne, 2008, 2010). This large range of outcomes stemmed from different understandings of equity that could be adopted. However, the moderate level of reductions required gave sufficient time to plan and to achieve the targets with domestic reductions.

Five years ago, growing knowledge on the risk of climate change led to in the adoption of a stricter goal under the Paris Agreement of limiting temperature increase to well below 2°C above preindustrial levels and undertaking efforts to limit it to 1.5°C. The IPCC presented information on the implications of a 1.5°C warming, comparing it to a 2°C world (IPCC, 2018).

Despite different interpretations by governments, it is clear that this new long-term goal is more ambitious than the previous below-2°C limit. Part of the scientific literature argues that the Paris Agreement states one single limit, i.e. the combination of well below 2°C and limit to 1.5°C, not two separate limits (either well below 2°C or 1.5°C) (Schleussner *et al.*, 2016; Wachsmuth, Schaeffer and Hare, 2018). The German Federal Environment Agency (UBA) "strongly advises climate policy at all levels to recalibrate climate mitigation efforts towards limiting warming to 1.5°C, including the European Union (EU)" (German Federal Environment Agency, 2018). Others do not accept 1.5°C as the driving limit and refer only to "well below 2°C" as the Paris Agreement's goal. In this discussion paper, we focus on mitigation pathways classified as pathways with limited overshoot of 1.5°C by the IPCC (IPCC, 2018), as these stay well below 2°C, in the sense that temperature increase peaks at 1.6°C and keep open the option to return to 1.5°C by the end of the century (Wachsmuth, Schaeffer and Hare, 2018). In the following, the term *1.5°C pathways* refers to this class of pathways.

Increasing emissions in the last 10 years and the new Paris temperature limit mean that today we have to reduce emissions three times faster: we now need to aim to halve global emissions in the next 10 years and reach net zero global CO_2 emissions by 2050 (Höhne *et al.*, 2020).

Under these very strict global requirements for mitigation pathways, differentiation of emission pathways between actors based on equity leads to more drastic pathways for many countries: Developed countries have already used most of their fair share of emissions and would have to reduce them to zero almost immediately (Höhne *et al.*, 2019). We refer to some examples in this study below. Such a result alone is however not instructive for a country that wants to set a target for its emissions. The discussion may be shut down as unrealistic before it has even started.

Conversely, equity-based approaches allow some of the poorer countries a strong increase of emissions far beyond 2050 (see the example of India below). If they were to use these allowances, basically no mitigation actions would be required in those countries.

To make the stringent global mitigation pathways possible, emissions in all countries have to be reduced as fast as possible. Whether a national emission pathway itself is in line with the responsibility and capability of that country becomes less relevant. It is now more a question of who pays for the transition, not where it is happening.

One therefore also needs to consider a different scenario that is based on the fastest possible way that a country could reach net zero emissions, even if that alone does not yet represent its fair share. Determining this scenario requires looking at technical options and the speed at which respective measures could be implemented.

As one option, these scenarios can be informed by global least-cost modelling, efforts that distribute emission reductions to countries and sectors where these reductions are the cheapest. Such "domestic mitigation potential" takes into account future development of energy services and sectoral differences between countries.

These results are however not universally accepted and called "unfair" by many actors because they usually require developing countries to reduce faster, as costs are assumed to be lower in most cases. It is usually less costly to build new carbon-free infrastructure (more common in developing countries), than to transform existing high-carbon infrastructure into low-carbon infrastructure (more common in developed countries). It is also more costly the decarbonise the higher consumption levels of developed countries than the lower consumption levels of developing countries.

More comprehensive insights for setting national emission targets therefore require both: equity-based effort sharing to determine the fair contribution of a country and the cost-effective domestic mitigation potential. Each approach on its own is insufficient. The cost-effective potential helps determining the domestic emissions pathway while the equity-based effort sharing informs the magnitude of financial transfers that are received to reach this path or provided to help others to reach this path.

3 Illustration how equity-based distribution and domestic potential fit together

To illustrate the concept and the dilemma, we provide results for the EU and India from Wachsmuth et al. (2019), which can be seen as illustrative examples for highly developed countries with only moderate future economic growth and transitioning countries with high growth expectations, respectively.

EU

The EU's equity-based emission level range according to the Climate Action Tracker in 2030 is wide: from 3.5 to -1.3 GtCO_2e. This large range can be narrowed down if one assumes that not all countries can pick the approach that is mildest to them, i.e. the least ambitious end of the range. Taking this into account, the fair emission level of the EU in 2030 is extremely low, around 0.8 GtCO_2eq compared to 4.3 GtCO_2e in 2015 (Figure 1). Essentially, the EU has already spent its fair share of emissions and has now no budget left; accordingly, it needs to reduce its emissions to zero almost immediately. Some stakeholders in the EU would turn away if one were to propose that the EU reduces its emissions to zero so rapidly, dismissing the proposal as unrealistic before even discussing it.

The exploitation of the globally cost-effective mitigation potential for 1.5°C pathways is still ambitious, leading to 2.3 GtCO_2e in 2030 for the EU, essentially halving emissions by then, which is within what is possible.

If the EU chooses a domestic emission target of that level, the difference of that target to the fair share can be an indication of the magnitude of financial transfers the EU would have to provide to other countries, e.g. India (see below), to provide a complete and fair contribution to the global mitigation effort.

India

India's fair share range would allow the country to double its emissions until 2030, the full range going from a small reduction to a factor of three. The low historical emissions, low economic development and large population are the driving factors that make even a significant increase a fair contribution.

However, it would not be in the spirit of the Paris Agreement if India's emissions were really to increase in the short term, as it could result in carbon lock-in making it more challenging to reduce emissions in the long run. For India, the potential provides a good indication of a path towards decarbonisation. In our example the potential from global least cost 1.5°C scenarios would be available to reduce emissions 30% from 2015 to 2030.

But as India would be entitled to higher emissions, much of the emission reductions should be paid for by others. The difference between the fair share and the potential can be an indication of the financial resources that are to be received.

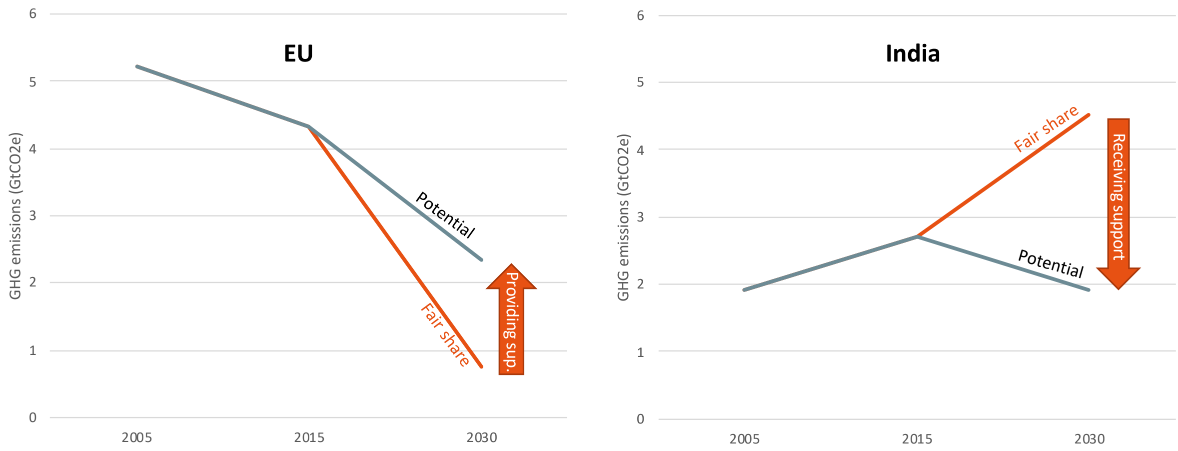

Figure 1. Gap between fair share and mitigation potential illustratively for the EU and India for 1.5°C pathways

Financial transfers

The combination of equity-based effort sharing and potential would imply significant financial transfers from developed to developing countries (Table 1).

The difference in emissions between equity-based effort sharing and potential can be taken as indication of the *direction*, but should be taken only with care as an indication of the *magnitude* of financial transfers. Some countries may be allocated more allowances than they need under business as usual conditions. One could also compensate this overallocation as an entitlement, but that would go beyond financing needed reductions.

These resources would need to be spent wisely to be most effective. They also would probably not finance the cheapest reductions in developing countries, because these are to be implemented by the country itself for meeting its already stringent domestic emission reduction targets. The financial resources should rather be used for "high hanging fruits": the activities that are not accessible to the country for domestic reductions, the transformational, innovative activities that are needed to go an extra step (Kachi, Warnecke and Höhne, 2019).

Denishchenkova et al. (2019) discuss how the design of a cooperative mechanisms (e.g. under Article 6 of the Paris Agreement) could foster a pathway to net-zero emissions based on the NDC baselines, positive and negative lists for technologies as well as additional criteria. Recipient governments can use such criteria to channel financial resources towards "high hanging fruits".

Table 1. Gap between the fair share and globally cost-effective mitigation potential by country in absolute GHG emissions

	Gap between the fair share and globally cost-effective mitigation potential in 2030 resulting in receiving financial transfers (positive) or providing (negative) [$GtCO_2e$]	
Country	**2°C-consistent**	**1.5°C-consistent**
Brazil	-0.17	-0.36
Canada	0.03	-0.01
China	1.54	1.49
Japan	-0.51	-0.83
India	3.72	2.59
United States	-0.60	-1.52
EU28	-0.83	-1.57
- thereof Germany	-0.32	-0.53

Source: Wachsmuth et al. (2019). Calculation based on data from the POLES-Enerdata model and the Climate Action Tracker. Values are positive for countries, where the cost-effectiveness-based reduction requirement is more stringent than its fair share reduction requirement.

4 Sector-specific emission reduction in line with 1.5°C

As explained above, globally cost-effective mitigation pathways in line with the long-temperature goal of the Paris Agreement can provide insights in the GHG emission reductions that should be achieved domestically. Countries with equity-based emission reductions exceeding domestic potentials would need to support other countries in using their more difficult-to-exploit domestic emissions reduction potentials. An indication of where these potentials lie can be deduced from the increase of ambition in cost-effective 1.5°C pathways compared to the former below-2°C pathways. We note that this is not meant to say that the difference corresponds to the gap between fair and cost-effective shares. Moreover, some caution is required in the interpretation due to uncertainties about future cost developments.

While below-2°C pathways require to reach net-zero CO_2 emissions only after 2065, the 1.5°C pathways with no or low overshoot arrive at net-zero CO_2 emissions already around 2050 (see Table 2). This would only be possible if CO_2 emissions from fossil fuels and industry were also reduced to a minimum until 2050 so that residual emissions could be compensated by natural carbon sinks. The net CO_2 emissions from fossil fuels and industry are reduced to 0 – 7 $GtCO_2$ in 2050 compared to about 40 $GtCO_2$ today, meaning a global reduction of 80 – 100%. Even more, 1.5°C pathways also require more ambitious reductions of energy- and process-related CO_2 emissions by more than 50% by 2030.

Table 2: CO_2 emissions from fossil fuels and industry (net)

IPCC SR1.5 category	No-overshoot 1.5°C	Low-overshoot 1.5°C	Hold below 2°C
2030	16.4 (18.2, 13.5)	20.1 (22.1, 16.8)	28.2 (31.0, 23.1)
2050	1.0 (7.0, 0.0)	3.0 (5.6, 0.0)	11.8 (14.1, 6.2)
Year of net-zero CO_2	**2037 – 2054**	**2047 – 2055**	**2065 – 2095**

Source: IPCC (2018). Values represent median across pathways in each category. Ranges represent interquartiles.

According to the IPCC SR 1.5 (IPCC 2018), there are large differences with respect to the energy system transformation between 1.5°C and 2°C pathways before 2050, in particular in end-use sectors, while the power sector is almost decarbonized by mid-century in both cases. An important finding of the IPCC SR1.5 is that pathways based on the NDC targets in 2030 and cost-efficiency afterwards show a carbon lock-in that persists long after 2030 as a result of delaying least-cost action until 2030. In this respect, national bottom-up scenarios may provide valuable insights in the sectoral mitigation potentials domestically available (Wachsmuth and Duscha, 2019).

Therefore we now take a detailed look at the sectoral emission reductions (energy supply, industry, buildings, transport) achieved by cost-effective 1.5°C pathways and compare them to below-2°C pathways, with a focus on the year 2030, which is particularly relevant for the update of the NDCs. To this end, we re-evaluate the results of Fekete et al., (2019) and Wachsmuth et al. (2019) for large emitters (Brazil, China, Canada, India, Japan, United States and the EU28) on the sector level.

The **energy supply sector** is comprised of emissions from electricity generation as well as transformation (centralized heat, refineries, etc.) and fugitive emissions from fossil fuel supply. It is responsible for the largest share of emissions in all of the large-emitting countries considered here (Fekete et al. 2019). Therefore, both the absolute and relative reductions of GHG emissions until 2030 are highest in this sector. An early reduction of GHG emissions in the energy sector is particularly important because there is a high risk of lock-ins due to the long investment cycles related to fossil fuel power plants (IPCC 2018).

A detailed look at the energy supply sector in globally cost-effective 1.5°C pathways reveals that there is a strong need for ambitious emission targets by 2030 compared to 2015 in order to foster a cost-effective mitigation pathway (see Figure 2): All countries need to reduce emissions from energy supply by about 50 – 60% by 2030 to be in line with a cost-effective 1.5°C pathway. While the relative emission reductions in the energy supply sector in China and India are substantially lower than those of other large emitters for a below-2°C pathway, the relative reductions reach a similar order of magnitude for the 1.5°C pathway. In particular, India would need a twice-as-high reduction in spite of its low equity-based share.

As the cost projections for renewable power plants have strongly decreased (Wachsmuth and Anatolitis, 2018), it is often economically viable to build renewable plants instead of new coal plants. However, there is also a need for shutting down existing coal plants, which usually leads to stranded assets and costs due to labour market effects. Hence, highly developed countries should consider financial support to other countries in the energy-supply sector. One option would be a “top up”: for each coal plant that the country replaces itself with renewables, developed countries offer to finance the replacement of an additional plant.

There is a large risk of emission lock-ins in the **industry sector** as well due to long investment cycles and the need to replace entire production processes in some industries, as a switch to renewable fuels is sometimes not possible. To reach a cost-effective 1.5°C pathway, both new industrial plants need to be based on new types of low-carbon production processes and the replacement of existing plants needs to start well before 2030, as the full replacement will take decades (IPCC 2018). In turn, there will be a high lock-in of emissions in the following decades if emission targets for the industry sector are not ambitious enough in 2030.

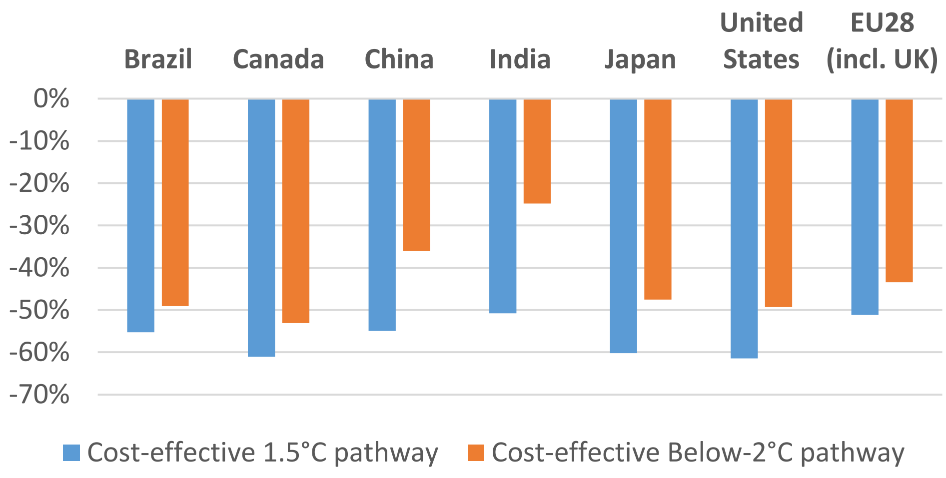

Figure 2: Relative change of GHG emissions in the energy supply sector by 2030 compared to 2015. Source: Own compilation of results from Fekete et al. (2019) and Wachsmuth et al. (2019)

A closer look at the industry sector in globally cost-effective pathways shows the following (see Figure 3): For the 1.5°C pathway, the emission reductions in the industry sector is in the order of 40% (Brazil) to 60% (Canada) by 2030 compared to 2015 for all large emitters considered here, except for India. For Brazil and China, this means that the emission reductions almost double compared to the outdated "below-2°C pathway". For the EU28, Japan, and the US, the level of emission reduction increases by about half. While India sees an increase of emissions in the industry sector for the below-2°C pathway, the industry emissions are also reduced for the 1.5°C pathway compared to 2015.

For the industry sector, highly developed countries should consider supporting the installation of plants based on innovative low- or zero-carbon processes in other countries in order to avoid the refurbishment of existing plants with much higher emissions.

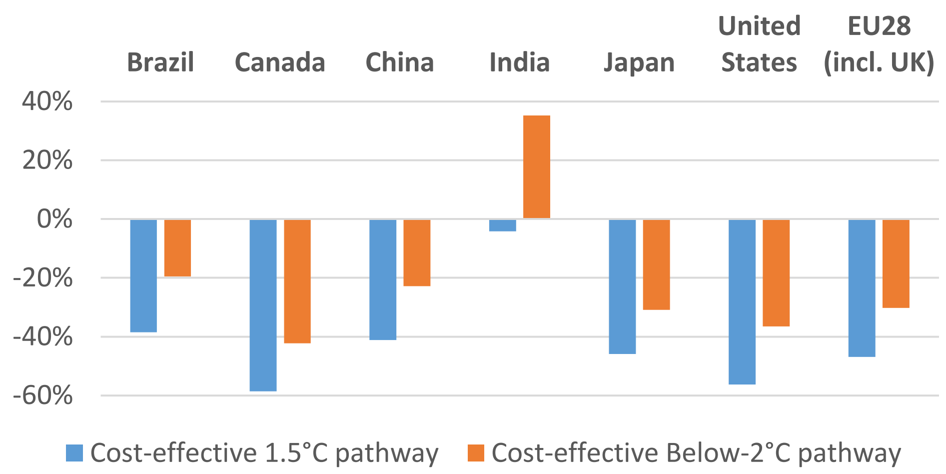

Figure 3: Relative change of GHG emissions in the industry sector by 2030 compared to 2015. Source: Own compilation of results from Fekete et al. (2019) and Wachsmuth et al. (2019)

In the **buildings sector**, which covers the emissions of households and the service sector, ambitious emission reductions are difficult to achieve due to the need to transform the existing building stock. The investment cycles for buildings can be longer than 50 years, which poses a high risk of a lock-in of emissions (IPCC SR1.5). To avoid a lock-in, it is not only necessary to accelerate the transformation of the building stock, but also to use best available technologies for constructing new buildings and renovating existing ones (Güneralp *et al.*, 2017). Therefore, it will not be possible to fully avoid emissions by mid-century unless emission targets for the buildings sector ensure substantial emission reductions before 2030.

A detailed look at the buildings sector in globally cost-effective 1.5°C and below-2°C pathway reveals the following: Even a cost-effective below-2°C pathway requires all large emitters considered here to reduce their emissions in the buildings sector by at least 20% and partly even up to 40%. A cost-effective 1.5°C pathway shows reductions of 35% (Japan) to almost 60% (China) by 2030 compared to 2015. This entails a substantial increase of emission reductions for all large emitters. For Brazil and India, in particular, this means doubling emission reductions to move to a cost-effective 1.5°C pathway (see Figure 4).

Therefore, highly developed countries should consider offering support schemes to other countries in the buildings sector, in order to finance the difference between a refurbishment based on best available technologies and suitably chosen current buildings standards.

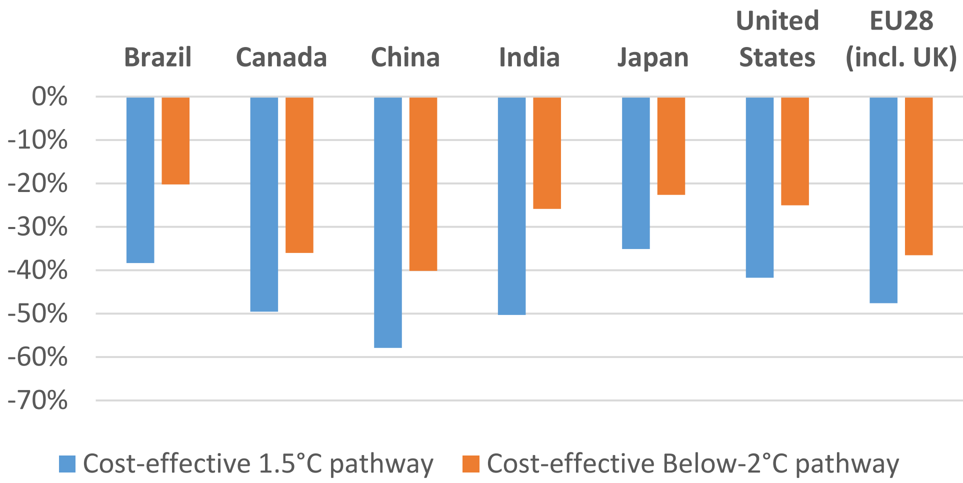

Figure 4: Relative change of GHG emissions in the buildings sector by 2030 compared to 2015. Source: Own compilation of results from Fekete et al. (2019) and Wachsmuth et al. (2019)

In the **transport sector**, the issue of lock-ins is not as strong as in the other sectors, as the investment cycle of the vehicle fleet is in the order of 15 years (Sims *et al.*, 2014). There can therefore be a complete switch between 2030 and 2050. However, the vehicle fleet is strongly influenced by the infrastructure, in particular highways and fuelling stations. Moreover, the activity within the transport sector is projected to increase strongly until 2030. To secure the GHG neutrality of the transport sector in the longer term, it will be necessary to transform the infrastructure in a suitable way, especially foster the electrification of transport, and to limit – or if possible even reduce – the activity of the transport sector (Creutzig, 2016).

A closer look at the transport sector in globally cost-effective pathways shows that ambitious emission targets for 2030 are also needed in the sector in order to foster a cost-effective 1.5°C pathway (see Figure 5): For Canada, Japan, the US and the EU28, the emissions in the transport sector already decrease in the order of 30% by 2030 compared to 2015 for a cost-effective below-2°C pathway. To reach a cost-effective 1.5°C pathway, they need to ramp up emission reductions to about 40% in the same period. Brazil, China and India need to limit the emission growth coming from the strong increase of transport activity; compared to a below-2°C pathway, a 1.5°C pathway requires to reduce such growth by half in Brazil and China and by about one third in India.

Limiting transport activity can be fostered by a suitable infrastructure, e.g. for public transport. Here, the highly developed countries should consider supporting the high upfront investments required to build such infrastructures.

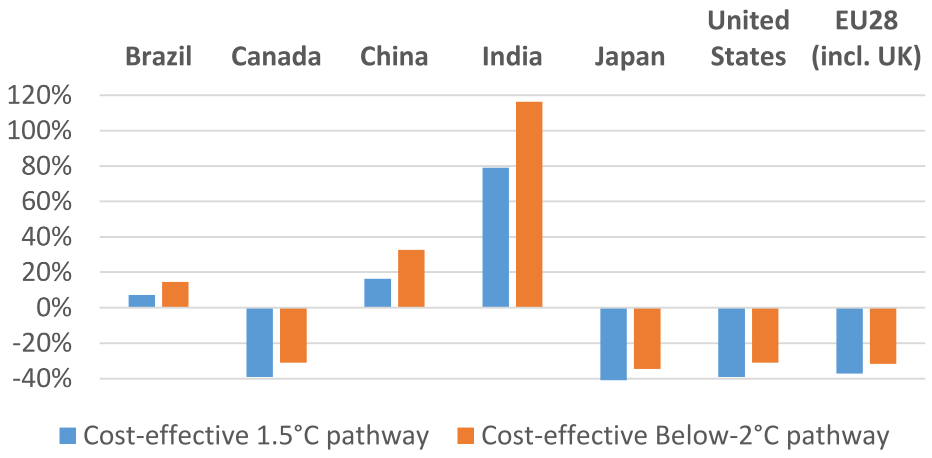

Figure 5: Relative change of GHG emissions in the transport sector by 2030 compared to 2015. Source: Own compilation of results from Fekete et al. (2019) and Wachsmuth et al. (2019)

5 Conclusions

In the longer term, all sectors and countries will need to reach GHG neutrality and in particular, mitigate all avoidable energy- and process-related GHG emissions, in order to be in line with a Paris-compatible pathway.

Given the agreement on the global challenge, the combination of equity-based assessments and domestic mitigation potential together can give guidance for exploring and setting national targets for greenhouse gas emissions that are in line with the goals of the Paris Agreement. While both methods yielded quite similar results only 10 years ago, they provide very different results today. The concept of a fair contribution applied only to domestic emissions may either stop the discussion before it started for developed countries (requiring net zero emissions within a decade) or suggesting that an increase in emissions is in line with the Paris Agreement for some developing countries for a longer period of time (while it is actually not).

To make the stringent global mitigation pathways possible, emissions in all countries have to be reduced as fast as possible. Whether a national emission pathway itself is in line with the responsibility and capability of that country becomes less relevant. It is now more a question of who pays for the transition, not where it is happening.

It is therefore fundamental that all countries explore their full mitigation potential, also considering global cost effectiveness or the “highest possible ambition“ as it is termed in the Paris Agreement. Until 2030 – most relevant for the updates of NDCs – substantial effort is needed in all sectors (energy supply, industry, buildings, transport), but speed of cost-efficient decarbonisation will be different across sectors and countries. From the sectoral evaluation, we conclude that national sector targets will be required in addition to national economy-wide targets, to avoid lock-ins in the more difficult-to-decarbonize sectors. In particular, there is a strong need for ambitious sector-specific 2030 targets, best enshrined in national law. Complementing global model results with national bottom-up scenarios can provide valuable insights about national leeway in this regard.

If the national potential is not substantial enough to represent a fair contribution (likely for most developed countries), these countries should support other countries to make the transition. If the highest possible ambition leads to faster reductions than the fair contribution (likely for many developing countries), these countries would receive financial support.

Such support should not finance the cheapest reductions in developing countries as such reductions are to be implemented by the countries themselves in order to set and meet their stringent domestic emission targets. The financial support should, in particular, help to avoid sectoral lock-ins which usually require much higher efforts compared to current NDC pathways, most of which were designed to be in line with the now outdated below-2°C limit. The difference between cost-effective 2°C and 1.5°C pathways can help identify difficult steps, although some caution is required in the interpretation due to uncertainties about future cost developments.

For instance, highly developed countries could support:

- In the energy supply sector: a “top up”, e.g. for each coal plant that the country replaces itself with renewables, developed countries offer to finance the replacement of an additional plant, especially when closing the plants is costly and requires significant societal change.
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- In the buildings sector: the transformation of building stocks based on the difference between globally best available technologies and a local building standard.
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The support of highly developed countries to other countries to reach a 1.5°C pathway can be addressed through various instruments, e.g. international climate finance through multilateral or development banks, but also through international market mechanisms to be established under Article 6.4 of the Paris Agreement. In addition to financial support, instruments to overcome non-financial barriers, such as labour constraints, will be required. Both financial and non-financial instruments must be designed to support high-ambition activities in a coordinated manner.

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