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International transfers under Article 6 in the context of diverse ambition of NDCs

Environmental integrity risks and options to address them

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International transfers under Article 6 in the context of diverse ambition of NDCs

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Abstract

This study assesses the environmental integrity risks of international carbon markets under Article 6 of the Paris Agreement and discusses possible international rules to address them. A considerable risk is that several countries have mitigation targets that correspond to higher levels of emissions than business-as-usual (BAU) projections. The amount of "hot air" contained in current NDC targets is estimated to be similar in magnitude as the total mitigation pledged by countries with NDC targets that are more stringent than BAU. If such hot air can be transferred to other countries, it could increase aggregated GHG emissions and create a perverse incentive for countries to set future NDC targets at less ambitious levels. In order to address these risks, international transfers could be subject to quantitative limits. We propose a typology for such limits, explore key design options, and road-test them in the context of 17 countries. Our analysis indicates that limits on international transfers, if designed appropriately, could prevent most of the hot air contained in current NDC targets from being transferred. The study also briefly explores approaches that aim to ensure unit quality to address the hot air risk, including international reporting and review, international guidance on mechanism design and implementation, and eligibility criteria.

CONTENTS

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SUMMARY

Article 6 of the Paris Agreement allows countries to use international carbon markets to achieve the mitigation targets outlined in their nationally determined contributions (NDCs). Article 6.2 allows countries to use "internationally transferred mitigation outcomes" (ITMOs) – where one country's climate change mitigation is claimed by another – to achieve their NDC targets. Article 6.4 establishes a new crediting mechanism under international supervision that could be used for similar purposes. Countries are currently negotiating the rules governing these approaches.

An important – and controversial – issue in the negotiations is whether and how international rules should promote environmental integrity. This study assesses some of the key risks to environmental integrity and discusses possible international rules to mitigate these risks, with a particular focus on options for limiting international transfers.

Environmental integrity risks in the context of current NDC targets

Independent assessments of NDCs suggest that some mitigation targets correspond to higher levels of emissions than business-as-usual (BAU) projections. In other words, some countries could overachieve their targets without further mitigation efforts. Such countries could thus *appear* to generate emission reductions (relative to their targets), without producing any *actual* emission reductions.

If this "hot air" is transferred as ITMOs to other countries – or carried-over and used to achieve future NDC targets – cumulative aggregated GHG emissions would increase, compared to a situation in which the same targets were achieved without transfers. Moreover, if countries benefit from the transfer of hot air, that could provide a disincentive for them to set more ambitious NDC targets in the future.

To understand the materiality of this risk, we compare NDC target levels with BAU emissions projections. It is important to stress that there are significant uncertainties in BAU emissions projections and challenges in interpreting NDC targets. Our analysis thus draws on two different data sources. This analysis is *not* an assessment of country-level NDC ambition; such an assessment would have to take into account equity and development considerations as well as other country circumstances (such as cost, availability, and feasibility of mitigation options). Here, we compare NDC targets and BAU projections with the sole purpose of understanding how material the risk of hot air is in international transfers under the Paris Agreement (and illustrating how potential remedies to this risk might work in practice).

Our analysis shows that at a global level there could be a significant amount of hot air under a broad range of scenarios and assumptions, similar in magnitude as the mitigation pledged by countries with NDC targets more stringent than BAU. Thus, while the results are uncertain for specific countries, they suggest that the overall risk of hot air is material.

We then turn our attention to how such hot air risks can be limited. In this report, we identify and examine two approaches considered in the ongoing international negotiations on Article 6: 1) establishing limits on the transfers of international mitigation outcomes, and 2) ensuring "unit quality" in international transfers.

Limits on international transfers

We examine two categories of limits on international transfers: **relative** and **absolute** limits. Under a **relative limit**, a country would be allowed to issue or transfer ITMOs to the extent that its actual emissions in the target year or period are below a specified limit. The limit could be based on a BAU emissions projection (as shown in Figure 1) or on another metric, such as aver-

age historical emissions. Under an **absolute limit**, a country could issue, transfer or acquire only a certain absolute (or fixed) number of ITMOs. This study assesses the implications of various options for relative and absolute limits by road-testing them in the context of 17 countries.

We use information on BAU projections and NDC targets from Climate Action Tracker (2015) to understand how various options for determining limits might work in various contexts. As noted above, it is important not to interpret or confuse this road-testing of limits with a more holistic assessment of country-level NDC ambition.

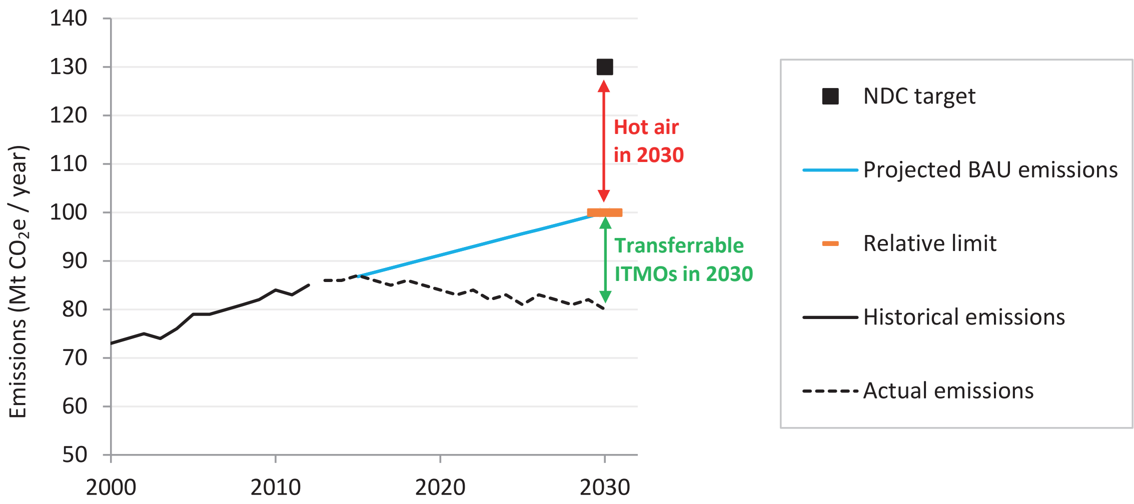

Figure 1: Relative limit based on a BAU emissions projection in 2030

Note: The figure illustrates the application of a relative limit for a country with a NDC target for 2030 (black square) that is less stringent than the projected BAU emissions (blue line). The country thus has hot air (red arrow). The country implements mitigation actions which bring its emissions (black dashed line) below BAU. In this example, the relative limit (orange line) is set exactly at the level of the BAU emissions in 2030. The amount of ITMOs the country is allowed to transfer in 2030 corresponds to the reduction of emissions below the limit (green arrow).

For relative limits, the road-testing shows that finding a suitable approach for determining the level of the limit is a critical challenge. Limits based on BAU emissions projections could be both technically and politically challenging. Countries could therefore consider alternative approaches, such as limits based on historical emissions or emission trends. The road-testing of these alternatives shows, however, that historical circumstances are often not representative of future developments, and trends often change over time. While some approaches effectively avoid the transfer of hot air from some countries, they do not work for the circumstances of other countries. None of the tested approaches reliably prevented the transfer of hot air for all tested countries while allowing the transfer of ITMOs that result from mitigation action. It was also not possible to identify groups of countries, such as developed or developing countries, for which a particular approach would consistently achieve these objectives.

However, relative limits based on average historical emissions – as proposed by Brazil – could be an interesting approach to consider further. This approach would imply that countries can only transfer ITMOs if they are on a decreasing emissions pathway. That would prevent the transfer of nearly all hot air contained in current NDC targets and could provide incentives for countries to engage in a decreasing emissions pathway. It could also be argued that the approach is consistent with the long-term goals of the Paris Agreement, which require global emissions to peak within the next decade. An important challenge of this approach is that most countries still have increasing emissions trends. Many countries would need to take significant additional mitigation action beyond their NDCs before they could engage in international transfers of ITMOs.

For absolute limits, the road-testing shows that limits would have to be set at low levels in order to be effective in preventing the transfer of hot air. A 1% limit, for example, would prevent about 90% of the hot air from being transferred. Limits, however, are bluntly applicable to all countries – irrespective of environmental integrity risks – and would *contain*, rather than *address*, the risk of transferring hot air.

For both relative and absolute limits, limits could be applied to only some types of transfers. Brazil, for example, proposes to only limit transfers under Article 6.2 and to allow countries to engage in international transfers under Article 6.4 without any limitation. Another option could be exempting international transfers that are backed by international linking of emissions trading systems. While this increases complexity, it may limit the types of transfers with higher environmental integrity risks and still enable countries to engage in international transfers that are more likely to result from mitigation action.

Ensuring unit quality in international transfers

If international transfers are backed by mechanisms that ensure unit quality, environmental integrity can be ensured even if NDCs contain hot air. Unit quality is achieved if the underlying mechanism ensures that the issuance or transfer of one unit, defined as 1 tCO_2e, is directly associated with an emission reduction of at least 1 tCO_2e in the transferring country.

This study identifies several ways in which international rules could promote unit quality. First, countries could be required to report on how they ensure environmental integrity and the reported information could be internationally reviewed. Second, international guidance could further define and clarify the term "environmental integrity" and elaborate on how mechanisms should be designed and implemented to ensure it. And third, mechanisms could be required to undergo an international approval process – similar to the approval of programs under the Carbon Offsetting and Reduction Scheme for International Aviation – before they can be used under Article 6 of the Paris Agreement.

Not surprisingly, the effectiveness of these approaches will depend on (a) the robustness and specificity of any international guidance or criteria; (b) the ability of the international review process to identify any issues; and (c) the willingness of Parties to implement corrective measures in response to identified issues.

Recommendations

International carbon markets can only achieve their objectives if they ensure environmental integrity. If environmental integrity is not ensured, they neither reduce emissions nor reduce the costs of mitigating climate change.

The risks to environmental integrity identified in this study are considerable. Current NDC targets appear to contain a significant volume of hot air. If international rules enable an unhindered transfer of hot air and countries engage in such transfers, aggregated GHG emissions could increase beyond the pledges in current NDCs. Moreover, countries could have incentives to set future mitigation targets at less ambitious levels. While ensuring unit quality could address these concerns, the experience from the Kyoto Protocol and existing carbon market mechanisms suggests that ensuring unit quality can be both technically and politically challenging.

Given these risks, identifying effective means to ensure environmental integrity is critical. Without international rules to promote environmental integrity, it is uncertain whether Parties will be able address these risks on their own. We therefore recommend that Parties consider the following environmental integrity provisions in rules under the Paris Agreement:

- **Relative limits** based on historical GHG emissions, such as those contained in proposals by Brazil. These could prevent the transfer of nearly all hot air contained in current NDC targets. Such limits, however, would only allow countries to transfer ITMOs if they are on a decreasing emissions pathway.

- **Absolute limits** set at sufficiently low levels to prevent any individual country from transferring large amounts of hot air. They are simple to implement and provide ex ante certainty on the volume of permissible transfers, but are bluntly applicable to all countries. They would thus *contain*, rather than *address*, the risk of transferring hot air.

- **International guidance, reporting, and review on mechanism design and implementation**, to help enhance the quality of units transferred internationally. Such guidance could also help prevent any potentially less robust mechanisms under Article 6.2 from "outcompeting" a more robust (and therefore more costly) mechanism under Article 6.4. The effectiveness of this approach hinges strongly on the specificity of the guidance and countries' adherence to it.

- **Eligibility criteria** applied to prospective mechanisms under Article 6.2, to enhance the quality of units transferred internationally. However, success would depend on the specificity of these criteria and on their consistent implementation.

The last two approaches also do not address situations in which countries transfer ITMOs without engaging in any mechanism.

It is important to stress that the effectiveness of these measures depends on *how* they are implemented. A loose limit on international transfers may have no impact on environmental integrity. Similarly, vague eligibility criteria or international guidance on unit quality and weak governance arrangements to ensure adherence may not affect the type and scale of transfers countries engage in. Whether an approach is effective may thus largely depend on the political feasibility to design it in a meaningful manner. Moreover, since it may be difficult to amend or introduce new rules once the Paris rulebook is in place, it is essential that Parties move swiftly to address the significant environmental integrity risks from hot air.

1 INTRODUCTION

Article 6 of the Paris Agreement introduces provisions that allow countries to use international carbon markets to achieve mitigation targets communicated in their nationally determined contributions (NDCs). Article 6.2 allows countries to use "internationally transferred mitigation outcomes" (ITMOs) – i.e., climate change mitigation achieved in one country but claimed by another – to achieve their NDC targets. Article 6.4 establishes a new crediting mechanism under international supervision that could be used for similar purposes. Countries are currently negotiating the rules governing these approaches.

Carbon markets are considered a key tool to reduce greenhouse gas (GHG) emissions. They aim to reduce the cost of achieving mitigation goals by providing flexibility in how and where emissions are reduced, and could thereby facilitate the adoption of more ambitious mitigation targets. However, if not designed and implemented appropriately, they could also result in greater GHG emissions than if they were not employed. The Paris Agreement therefore requires Parties to ensure "environmental integrity" when engaging in international transfers of mitigation outcomes.

The international transfer of mitigation outcomes involves a number of environmental integrity risks, as explored in the literature (Schneider, Füssler, La Hoz Theuer, et al. 2017; Kreibich and Hermwille 2016) and highlighted in Parties' submissions to the United Nations Framework Convention on Climate Change (UNFCCC)[1]. A key risk are international transfers from countries with weak mitigation targets. Under the Kyoto Protocol, some countries had mitigation targets which did not require the country to take any mitigation action. This created surplus units that were often referred to as "hot air". If countries have such mitigation targets, they could *appear* to generate emission reductions (i.e. relative to their targets), and could transfer these to other countries without engaging in any *actual* emission reductions. This could lead to an increase in global GHG emissions compared to a situation where targets were reached in the absence of such international transfers. Under the Kyoto Protocol, the international transfer of surplus units has indeed undermined the mitigation impact of the Protocol (Kollmuss et al. 2015).

Similar risks could arise under the Paris Agreement. Some NDC targets appear to require considerable mitigation action to be achieved; others appear to be set so that countries might easily meet or exceed them, even if the countries take no further mitigation action. In their submissions to the UNFCCC, several Parties point to the risks of international transfers of hot air under the Paris Agreement. Hot air is also mentioned in an informal note from the co-facilitators of negotiations under Article 6.2 during the 46th session of the Subsidiary Body for Scientific and Technological Advice (SBSTA), as part of a list of issues raised by the Parties.[2]

This study assesses the environmental integrity risks from international transfers under Article 6 of the Paris Agreement in the context of the diverse ambition of NDC targets. It also identifies and assesses possible ways to address these risks, with a particular focus on establishing limits on international transfers. While a number of Parties have proposed such limits, their implications have not yet been assessed.

The study first discusses possible definitions of environmental integrity and identifies which factors influence environmental integrity in the context of international transfers under the Paris Agreement (Section 2). One of the key factors is whether NDC targets contain hot air. We therefore assess in Section 3 the potential for current NDC targets to result in transfers of hot air. Towards this end, we provide an overview of the type of mitigation targets in current NDCs, discuss possible definitions of hot air, and estimate the volume of hot air contained in current NDC targets, drawing upon two data sources.

1 http://www4.unfccc.int/submissions/SitePages/sessions.aspx?showOnlyCurrentCalls=1&populateData=1&expectedsubmissionfrom=Parties&focalBodies=SBSTA

2 http://unfccc.int/files/meetings/bonn_may_2017/in-session/application/pdf/sbsta_10a_informal_note_final.pdf

We then turn to possible ways to address environmental integrity risks. In this context, drawing on the experience and lessons learned from the Kyoto Protocol is important. Section 4 therefore first summarizes the experiences and lessons learned from the Kyoto Protocol on international transfers and on carry-over from countries with unambitious targets. Section 5 provides then an overview of which approaches could be pursued by Parties to address the risk of international transfers from countries with unambitious NDC targets. In section 6, we discuss limits on international transfers. We explore different approaches for establishing limits and examine their suitability and implications for different countries. A key element is the road-testing of different types of limits to 16 countries with diverse NDC targets and circumstances. Section 7 explores possible ways and options for ensuring unit quality in international transfers, including reporting and review; international guidance on environmental integrity and the design of mechanisms; and eligibility criteria. While we focus on regulatory approaches that could be pursued under the UNFCCC, we also briefly touch upon approaches that could be pursued outside the UNFCCC and its Paris Agreement, such as carbon clubs.

The study also briefly explores a related issue: environmental integrity risks from a possible carry-over under the Paris Agreement. Under the Kyoto Protocol, countries can carry-over unused compliance units from the first to the second commitment period. The Paris Agreement does not include such provisions, but some Parties have proposed establishing carry-over provisions. Section 8 briefly explores the environmental integrity risks from a possible carry-over under the Paris Agreement and whether and how limits could be applied in this context. Lastly, Section 9 draws conclusions.

This study makes specific assumptions and uses specific terminology. For simplicity of terminology, we use the term "ITMOs" to refer to transfers of mitigation outcomes or emission reductions that could be generated either under Article 6.2 or Article 6.4 of the Paris Agreement, although our findings still hold even if international transfers of emission reductions generated under Article 6.4 are not considered as ITMOs. Article 6.2 of the Paris Agreement does not specify what an ITMO is and how transfers should take place. ITMOs could be international units that are transferred between electronic registries or they could be amounts that are reported by countries for accounting purposes. We assume here that ITMOs are not international units but amounts reported by countries. It is further assumed that ITMOs are expressed in metric tonnes of CO_2 equivalent (tCO_2e); again, the findings of the study would hold if this were not the case, although subject to other complexities (Schneider, Füssler, Kohli, et al. 2017).

We further assume that cooperative approaches under Article 6.2 may or may not involve "mechanisms" such as crediting mechanisms and emission trading schemes (ETSs). Where mechanisms are involved, we assume that they issue "units". These could include "credits" issued under crediting mechanisms or "allowances" issued under ETSs. The net flow of units between countries may or may not be accounted for as ITMOs, subject to the arrangements of the Parties involved in the transfer.

We further assume, importantly, that countries achieve their NDC targets. As many NDCs are conditional on international support, we thus assume that support is provided. We further assume that ITMOs and any carry-over are used towards achieving NDC targets. Noting that the nature and scope of ITMOs are yet to be defined, this study does not consider situations where ITMOs are used outside the context of NDC targets, such as under international aviation or for cancellations in the context of voluntary offsetting or for a results-based climate finance programme. We also assume that robust accounting will be applied both to international transfers under Article 6 and to any domestic carry-over.

2 WHAT DOES "ENVIRONMENTAL INTEGRITY" MEAN IN THE CONTEXT OF INTERNATIONAL TRANSFERS AND THE PARIS AGREEMENT?

Environmental integrity is a key principle under Articles 4 and 6 of the Paris Agreement. Article 4.13 requires Parties to "promote" environmental integrity when accounting for their NDCs. Article 6.1 requires Parties to "promote" environmental integrity when pursuing voluntary cooperation in the implementation of NDCs. Article 6.2 requires Parties to "ensure" environmental integrity when engaging in cooperative approaches, although without specifying how to achieve it. Lastly, Article 6.4 does not explicitly refer to environmental integrity, but the decision 1/CP.21 adopting the Paris Agreement establishes several provisions that aim to safeguard it – such as provisions for "real, measurable, and long-term" mitigation benefits and emission reductions that are "additional to any that would otherwise occur."

In Section 2.1 we consider several ways to define "environmental integrity" in the context of international transfers and propose a definition. In Section 2.2 we identify which factors influence the environmental integrity of international transfers. Section 2.3 then investigates how unit quality and the ambition of NDC targets influence the GHG emissions impact of international transfers.

2.1 How can environmental integrity be defined?

Environmental integrity is not defined under the UNFCCC or the Paris Agreement, and can be understood in different ways. We identify three possible approaches for defining environmental integrity with respect to international transfers:

1. **Environmental integrity is ensured if mitigation targets are achieved**: Woerdman (2005), for example, defines environmental integrity (or "environmental effectiveness") as achieving a certain aggregate emission target that is the sum of national targets under the treaty. Under such an approach, environmental integrity is ensured if the international transfer of ITMOs does not lead to a situation where aggregate actual emissions would exceed the aggregated target level.

2. **Environmental integrity is ensured if international transfers do not lead to an increase in global GHG emissions**: The Intergovernmental Panel on Climate Change (IPCC) defines the "environmental effectiveness" of a certain mitigation policy as "the extent to which it achieves its objective to reduce the causes and impacts of climate change" (IPCC 2014, sec.13.2.2.1). Moreover, the IPCC's assessment of the environmental effectiveness of the Kyoto Protocol flexibility instruments (IPCC 2014, sec.13.13.1.1) indicates that it interprets the environmental integrity of carbon markets in the context of impacts on global aggregate GHG *emissions*, rather than the achievement of Kyoto targets. Under such an approach, environmental integrity is ensured if the international transfer of ITMOs leads to the same or lower aggregated global GHG emissions as compared to a situation where international transfers did not take place.

3. **Environmental integrity is ensured if international transfers lead to lower global GHG emission levels**: This approach could build on the objectives in Article 6.1 of enhancing ambition or the objective of the Article 6.4 mechanisms to achieve an "overall mitigation in global GHG emissions". Under this definition, environmental integrity would be ensured if the international transfer of ITMOs leads to an overall decrease in global GHG emissions. This approach could be operationalized in different ways. One approach could be that international transfers could be seen to promote environmental integrity if they were consistent with the achievement of a certain long-term goal or with a certain effort distribution – such as an emissions pathway to stay within a specific temperature goal. Another approach could be ensuring that some of the emission reductions transferred are neither used by the transferring nor by the acquiring country to achieve their NDC targets.

The first approach would imply that global GHG emissions could increase as a result of engaging in international transfers, as long as emissions do not exceed aggregate targeted levels. This approach does not seem consistent with the general principles of the Paris Agreement and could also undermine the principle that cooperation under Article 6 should "allow for higher ambition" (Article 6.1).

The third approach integrates the objective of enhancing ambition into the definition of environmental integrity. Raising ambition and ensuring environmental integrity are two different concepts in the Paris Agreement. Combining these concepts might involve complex discussions and could dilute each of them. Conflating ambition with the environmental integrity of international transfers could be counterproductive in providing clarity on their effect as a tool for mitigation action. Assessing whether countries have mitigation targets that are consistent with the long-term goals of the Paris Agreement would also raise politically controversial questions around normative emissions pathways and equity.

In this paper, we employ the second definition. This definition is practical to implement and operationalize, and avoids the overlap with the principle of raising ambition.

2.2 What influences environmental integrity?

If environmental integrity means that engaging in international transfers should not result in higher emissions (compared to not engaging in international transfers), then environmental integrity is influenced by four factors (Schneider, Füssler, La Hoz Theuer, et al. 2017):

1. **Robust accounting of transfers**: If a transfer is not accounted for robustly, global GHG emissions could increase as a result of the transfer. Robust accounting requires, *inter alia*, that double counting is avoided (e.g. by appropriately crediting and debiting national emissions accounts), that NDC targets are expressed in quantitative terms (e.g. as absolute GHG emissions levels), and that vintage of mitigation outcomes and the timeframe of NDC targets are appropriately accounted for.

2. **Quality of units**: Carbon market mechanisms, such as emissions trading systems (ETSs) or crediting mechanisms, usually issue electronic units which can be transferred within or between registries and which typically correspond to 1 tCO_2e of emissions, or emission reductions. If such units are internationally transferred, countries could count the net flow of units as ITMOs when achieving their NDC targets. Countries could also establish a system of international units, such as under the Kyoto Protocol. We define here that units have "quality" if the underlying mechanism ensures that the issuance or transfer of one unit, defined as 1 t CO_2eq, is directly associated with an emission reduction of at least 1 t CO_2eq in the transferring country, compared to the situation in the absence of the mechanism. Hence, we consider here the direct emissions outcome from the underlying mechanism, independently of other factors, such as the ambition and scope of the NDC target of the transferring country. The factors that affect the unit quality depend on the type of mechanism:
   - Under **crediting mechanisms**, the quality of credits is ensured if the mitigation action generating the credits is additional (that is, it would not have occurred in the absence of the incentives from the crediting mechanism); the emission reductions achieved by the mitigation action are not overestimated; and the emission reductions are permanent (or provisions are in place to address non-permanence). The quality of credits thus encompasses what the Clean Development Mechanism (CDM) refers to as "real", "additional", "permanent" and "measurable" emission reductions. Verification (as required in the CDM) is an important component for ensuring that emission reductions are not overestimated. The available evaluations of crediting mechanisms question the quality of credits from some project types (Cames et al., 2016; Erickson et al., 2014; Spalding-Fecher et al., 2012).

- Under **emission trading systems** (ETSs), the quality of allowances mainly depends on: whether the ETS cap is set below the emissions level that would occur in the absence of the trading system; and whether emissions are monitored appropriately. If an ETS with an ambitious cap is linked to one that is over-allocated, linking could reduce aggregated abatement from both systems. Assessing the ambition of ETS caps can be difficult, particularly if different time horizons have to be taken into account. In nearly all ETSs established to date, however, over-allocation of allowances seems to be a pervasive problem (IETA 2015).
- Countries could potentially also pursue **other types of mechanisms**, such as green investment schemes (GISs). Where units are issued for specific mitigation actions, the quality of the transferred units hinges on similar criteria as that for crediting mechanisms. Where units stem from a budget of units allocated to countries or entities, the quality of the transferred units hinges on criteria similar to those for an ETS. Where direct bilateral transfers occur without implementing any mitigation action, the transferred units would not have quality. Assessing the quality of units from other types of mechanisms is often hindered by the lack of transparency in the implementation and verification of emission reductions achieved.

The Paris Agreement could also enable **ITMO transfers that are not backed by a mechanism**. These transfers could be the direct result of mitigation action, notably if a country overachieves an ambitious NDC target. Transfers could also, however, *not* be associated with mitigation action – e.g. where countries transfer hot air. ITMO transfers that are not backed by a mechanism may pose higher risks to environmental integrity.

3. **Ambition and scope of the NDC target of the transferring country**: The NDC target of a transferring country can affect the global GHG emissions impact of a transfer *indirectly*, because the target's scope and ambition may determine whether transferring units that lack quality impacts the country's efforts in achieving its NDC target. Assume a country that issues a unit that lacks quality for emission reductions that fall within the scope of the country's NDC target and transfers the unit to another country. The countries involved in the transfer agree to account for the unit transfer as ITMOs. If the transferring country has an ambitious NDC target, it would have to compensate for the transfer in order to still achieve its NDC target, either by further reducing emissions or by purchasing ITMOs. The country has thus an incentive to ensure that units generated by mechanisms have quality. The same may not be true, however, for countries with NDC targets less stringent than BAU, or for units issued for emissions or emission reductions that fall outside the scope of the NDC target, as will be further detailed in Section 2.3.

4. **Incentives or disincentives for future mitigation action**: The possibility to engage in international transfers could provide incentives or disincentives for future mitigation action. For acquiring countries, international carbon markets could lower the cost of mitigation, and thereby enable these countries to adopt more ambitious targets. Yet for transferring countries, participation in international carbon markets could create disincentives to adopt ambitious targets. The possibility to participate in international transfers could thus affect global GHG emissions indirectly. Several studies have modelled countries' possible target-setting behaviours vis à vis the possibility to engage in international transfers. They conclude that the possibility (or anticipation) to engage in international transfers can lead to higher GHG emissions compared to a situation without the possibility to engage in such transfers – because the perverse incentives for transferring countries to reduce the ambition of their mitigation targets can outweigh the incentives for acquiring countries to enhance the ambition of their mitigation targets (Carbonne et al. 2009; Helm 2003; MacKenzie 2011; Rehdanz and Tol 2005; Holtsmark and Sommervoll 2012).

In this study, we focus primarily on environmental integrity risks posed by international transfers from countries with unambitious NDC targets.

2.3 How do unit quality and NDC targets affect the global GHG emissions impact of ITMO transfers?

In this section, we investigate specifically the relationship between unit quality and the NDC target of the transferring country, in particular under which conditions a lack of unit quality leads to an increase in global GHG emissions.

Whether a lack of unit quality affects global GHG emissions depends on both the level and the scope of the transferring country's NDC target. First, the level of the target is important. If an NDC target can be achieved with existing policies and does not require the country to pursue mitigation action, then the country would not have to compensate for a transfer of units that lack quality, by reducing emissions further or purchasing ITMOs. By contrast, if the NDC target is ambitious, the country would have to pursue further mitigation to compensate for the transfer of units that lack quality. The more ambitious an NDC target is, the more likely it is that a country would compensate for the transfer of units that lack quality. Whether the country compensates may also depend on when transfers are made. Before the target year or period, the country may not have certainty whether it will achieve its target and may take a cautious approach. However, once over-achievement of the target level becomes certain, the country may have less incentives to ensure unit quality and may no longer compensate for the transfer of units that lack quality. For simplicity, we assume here that a country would have to compensate for the lack of unit quality, if its NDC target is more stringent than business-as-usual (BAU) emissions.

Second, the scope of a transferring country's NDC target will also play a role on whether unit quality affects environmental integrity. If a unit is issued for emissions outside the scope of the country's NDC, then a lack of unit quality will have implications similar to when the country's NDC target is less stringent than BAU emissions.

Table 1 illustrates how the level and scope of the transferring country's NDC target impacts global GHG emissions under different scenarios of unit quality. It assumes that robust accounting is applied and that the possibility to participate in international carbon markets provides no incentives or disincentives for future mitigation action. It is further assumed that both countries involved in the international transfer would – without the transfer taking place – exactly achieve their NDC targets. Impacts on global GHG emissions are compared to a situation where no international transfers take place.

Table 1: GHG impact of international transfers in different scenarios of NDC targets and unit quality

Scope and level of the NDC target of the transferring country	Quality of units	Impact on global GHG emissions*
NDC target more stringent than BAU, and reductions fall within the scope of the NDC target	> 1 tCO_2e	Zero
	= 1 tCO_2e	Zero
	< 1 tCO_2e	Zero
No NDC target, or reductions fall outside the scope of the NDC target	> 1 tCO_2e	Decrease
	= 1 tCO_2e	Zero
	< 1 tCO_2e	Increase
NDC target less stringent than BAU	> 1 tCO_2e	Decrease
	= 1 tCO_2e	Zero
	< 1 tCO_2e	Increase**

Source: Schneider, Füssler, La Hoz Theuer, et al. (2017)
(*) Compared to a situation where no international transfers take place.
(**) As long as the disparity between actual reductions and transferred units is smaller than the difference between BAU emissions and the NDC target.

If the transferring country has an NDC target that is more stringent than BAU, then global GHG emissions within the scope of the NDC target are not affected, no matter the quality of the transferred units. If the transferred units lack quality – say, the mechanism generates only 0.5 tCO_2e of reduction for one unit transferred – then only 0.5 tCO_2e are reduced in the transferring country, whereas the acquiring country can increase its emissions by 1 tCO_2e above its NDC target. If robust accounting is applied on the basis of "corresponding adjustments" as envisaged under Article 6.2 of the Paris Agreement, the transferring country would have to add a corresponding adjustment of 1 tCO_2e to its reported emissions (or subtract an equivalent amount from its emissions trajectory), while its emissions only decrease by 0.5 tCO_2e – leaving the country with a net *deficit* of 0.5 tCO_2e to achieve its NDC target. To still achieve its NDC target, the transferring country must "compensate" for this deficit by reducing its emissions by 0.5 tCO_2e more. If the transferring country takes such action, global GHG emissions are not affected.

If the transferring country does not have an NDC target or if the reductions fall outside the scope of its NDC target, the quality of units directly impacts global GHG emissions: if the transferred units lack quality, then global GHG emissions could increase; if the mechanism generates only 0.5 tCO_2e of reduction for a unit transferred, then only 0.5 tCO_2e are reduced in the transferring country, whereas the acquiring country can increase its emissions by 1 tCO_2e above its NDC target. Global emissions would thus go up by 0.5 tCO_2e, because the transferring country lacks an incentive to compensate for the disparity between actual reductions and transferred units.

If the transferring country has an NDC target that is less stringent than BAU, the quality of units also directly impacts global GHG emissions. That's because the application of corresponding adjustments would have no bearing for the transferring country in achieving its NDC target: if the transferred units lack quality, the transferring country would have no incentive to compensate for the net *deficit* with further reductions, because it would achieve its NDC target regardless. This effect of increasing GHG emissions persists as long as the deficit is smaller than the difference between BAU emissions and its NDC target.

Two important conclusions can be drawn from this analysis:

- First, ambitious NDC targets create an incentive to ensure that internationally transferred units have quality: countries with ambitious NDC targets have a direct incentive to ensure the quality of units generated for emissions or emission reductions within the scope of its NDC that are transferred to other countries. By contrast, if the emission sources are not included within the scope of NDC targets, or if NDC targets are less stringent than BAU, transferring countries may not have a direct incentive to ensure unit quality. They might accrue more financial revenues from over-estimating emission reductions and could do so without infringing their ability to achieve their NDC targets.

- Second, a lack of unit quality is critical in two situations: if the emission sources are not included within the scope of an NDC target, or if the transferring country has an NDC target less stringent than BAU. In these cases, a lack of unit quality would lead to higher global GHG emissions.

3 NDC TARGETS AND ENVIRONMENTAL INTEGRITY

Under the Paris Agreement, Parties shall communicate NDCs every five years (Article 4.9). A key principle of the Paris Agreement is that NDC targets are self-determined by the country. The self-determined nature of NDCs has led to a wide diversity of NDCs put forward by Parties, including with regard to the type, scope, metrics and ambition of mitigation targets (Graichen et al. 2016; Howard, Chagas, Hoogzaad, et al. 2017).

As discussed in Section 2.3, whether a country has an NDC target that is more or less stringent than BAU emissions can affect its incentives for ensuring unit quality and safeguarding environmental integrity. In this section, we illustrate the potential environmental integrity risks posed by NDC targets that may be less stringent than BAU. Section 3.1 provides a brief overview of the different type of NDC targets communicated by countries. Section 3.2 discusses the many challenges in establishing BAU emissions projections. Section 3.3 proposes a definition of "hot air". Finally, section 3.4 provides estimates on the amount of hot air contained in current NDC targets, in accordance with the proposed definitions.

3.1 Diversity and clarity of NDC targets

In their first NDCs, countries have communicated several types of mitigation targets (Graichen et al. 2016; CAIT Climate Data Explorer 2016). Some targets are economy-wide, whereas others cover only specific sectors; some are expressed as GHG emissions targets, others use non-GHG metrics, such as the share or capacity of renewable energy. NDCs also differ in the GHGs covered and in the use of global warming potentials.

Some countries have communicated only one NDC target, while many countries have communicated different types of targets – including complementing GHG emission targets with other types of targets, such as targets for the share of non-fossil fuel energy. Some countries not only provided a single target value but a target range, and some countries communicated a conditional and an unconditional target. This leads to several possible target levels for a single country, and it is not always clear which of the targets or target levels countries intend to achieve under which conditions.

For many NDCs, the scope and target level of NDCs is not fully clear. For some countries, for example, it is not fully clear whether the target covers the entire economy or whether some sectors or gases are excluded. Many countries have targets expressed as a deviation from future BAU emissions. In these instances, it is not always clear whether BAU emissions projections will be updated in the future. Some countries indicated that their single-year target will be translated into a multi-year emissions trajectory, but it is not clear how this trajectory will be determined. Many countries also aim to account for emissions and removals from land use, land-use change and forestry (LULUCF) but have not clearly set out how they will account for this sector. The GHG emissions resulting from NDC targets are thus often uncertain and can only be estimated.

This poses several challenges. It makes it more difficult to inform international efforts to increase the ambition of NDC targets over time. Clarity of NDC targets is also a prerequisite for the accounting for NDC targets (Articles 4.13 and 13) and accounting for international transfers (Article 6). Moreover, it is important to understand NDC targets in order to assess the environmental integrity implications of international transfers under Article 6. Guidance on the features, information and accounting of NDCs (as mandated by paragraphs 26, 27–28 and 31–32 of Decision 1/CP.21, respectively) is currently being negotiated by the Ad Hoc Working Group on the Paris Agreement.

3.2 Estimating BAU emissions projections

BAU scenarios are hypothetical emissions projections that aim to estimate how GHG emissions could unfold under a certain set of assumptions. They thus reflect how countries' emissions are *likely* to unfold in the future, and are not a normative determination of how emissions *should* unfold. Conducting BAU emissions projections is subject to several challenges and uncertainties and involves a number of important considerations.

3.2.1 Consideration of mitigation policies

A first key question is how and as of when mitigation policies are considered in estimating BAU emissions (see, e.g., Rogelj et al. 2016). BAU emissions could be estimated assuming that already implemented mitigation policies were not implemented (a "no-policy" scenario); that only existing policies are implemented (a "current policies" scenario); or that new policies will be implemented in response to the target being proposed (a "new policies" scenario) (IEA 2016). Which scenario is most suitable depends on the objective pursued. For the purpose of ensuring environmental integrity of international transfers of ITMOs, a key consideration is whether a country already over-achieves its NDC target under current policies or whether it has to adopt further policies to achieve its NDC target. We therefore focus our assessment on BAU emissions projections with current policies in place.

3.2.2 Assumptions and uncertainties

BAU emissions projections are based on assumptions about future developments and therefore involve considerable uncertainties. Future emissions depend on many uncertain parameters, including economic growth, international fuel prices, technology development, and climatic changes. Data availability and quality often also present difficulties, and some of the assumptions (such as those on economic growth) can be influenced by political and economic interests.

Various approaches can be pursued to reflect the uncertainty of BAU emissions projections. The uncertainty can be reflected by estimating a band of the future emissions level, rather than a single value. Alternatively, a single value can be provided that aims to reflect the *most likely* future development, where most likely means that there is a 50% chance that emissions will be higher and a 50% chance that emissions will be lower than the estimated projection. A third approach is estimating BAU emissions in a "conservative" manner, making assumptions that tend to underestimate, rather than over-estimate, future emissions.

3.2.3 Methods for deriving emissions projections

Various methods can be employed to derive emissions projections. For example, the (PMR 2015) lists four key options to draw "baseline pathways":

- **Trend extrapolation**: Economic activity and the emissions intensity are projected on the basis of historical trends.
- **Augmented extrapolation**: An augmented version of the first option, whereby factors are taken into account that would be expected to lead to future development trends differing from those seen in the recent past.
- **Decomposition projection**: An analysis of past emissions drivers can be used to identify the relationship between emissions and these drivers. Forward-looking projections of these key drivers can then be used to develop a baseline pathway.
- **Detailed bottom-up analysis**: Making use of national projections of economic development, it is possible to develop an understanding of the possible future development of activity drivers (such as electricity generation demand, vehicle use and waste generation) and multiply these with possible future emissions factors.

These approaches increase in the level of precision and sophistication, and different approaches can be used for different sectors depending on data availability and analytical capacities (PMR 2015).

3.2.4 Timing of BAU emissions projections

A further important consideration is when BAU emissions projections should be conducted. The projected BAU emissions level can depend considerably on when the projection is made: over time, the factors affecting BAU emissions can change. This relates to the mitigation policies that are in place or planned, as well as the assumptions used to derive emissions projections. Unforeseen developments, such as natural catastrophes or an economic crisis, could, for example, significantly alter emission pathways and would hence also affect the level of BAU emissions projections when they are updated. According to Shishlov et al. (2016), the total impact of the 2008–2009 financial crisis on the emissions of Annex B countries was of comparable magnitude to the impact of the economic contraction of economies in transition following the collapse of the Soviet Union. Another example are the disruptions to the energy system in Japan after the Fukushima Daiichi disaster, which led to higher GHG emissions than originally envisaged (OECD 2017).

This poses considerable challenges when comparing mitigation targets with BAU emissions projections. At the time of target-setting, a target may be more stringent than BAU emissions projections; years later, that same target could be less stringent than an updated BAU emissions projection. The updated BAU emissions projection could differ from earlier projections because the country implemented mitigation policies that put it on a path to target overachievement, or because of unexpected changes such as an economic crisis. Conversely, a target that was initially less stringent than BAU emissions projections could be found to be more stringent than an updated BAU projection established years later, perhaps due to a natural catastrophe that led to higher-than-expected emissions.

In theory, BAU emissions projections could aim to distinguish the effects of climate policies from other factors that affect emissions pathways, such as economic growth. BAU emissions projections could, for example, be based on the mitigation policies that were in place at a given point in time – e.g. at the time of setting the target – but also take into account recent developments of other factors affecting emissions pathways. For example, in their no-policy baseline scenario, Rogelj et al. (2016) assume that no new climate policies have been put into place from 2005 onwards. In practice, however, it can be methodologically difficult to clearly differentiate the effect of climate policies from other factors.

A further difficulty is that a target isn't the only reason countries implement climate policies. They could also implement policies in anticipation of future mitigation targets or for reasons other than addressing climate change, such as reducing air pollution, reducing dependency on fossil fuels or achieving economic efficiency gains.

These challenges raise the question which BAU emissions projection to consider. For the purpose of this study, we use BAU emissions projections conducted *at the time of setting the target*. An important rationale for this approach is that countries base their NDC targets on the circumstances that are known or expected when setting the target. This means that changing circumstances that can alter emission pathways after the target is set are not reflected in the projections.

3.3 Definition and risks of "hot air"

No agreed definition of "hot air" exists. The term was originally coined around the negotiations following the adoption of the Kyoto Protocol, and it was generally understood as a surplus of units that results from an emissions target set at a level that is more lenient than the expected emissions in the relevant period. Some authors define hot air as a result of economic downturn specifically (Paltsev 2000), whereas others define it more broadly as the result of targets that are less ambitious than BAU emissions projections (Schneider, Füssler, La Hoz Theuer, et al. 2017; Boehringer 2000; den Elzen and de Moor 2002; Kollmuss et al. 2015). The UNFCCC glossary of terms (UNFCCC n.d.) lists hot air as "the concern that some governments will be able to meet their targets for greenhouse-gas emissions under the Kyoto Protocol with minimal effort and could then flood the market with emissions credits, reducing the incentive for other countries to cut their own domestic emissions."

To address the risks of hot air under the Paris Agreement, it may be helpful to explore possible definitions of hot air. When a country overachieves its target, a distinction could, in theory, be made between overachievement that is the result of abatement effort and overachievement that is not. Marcu (2017) refers to these categories as "good surplus" and "bad surplus" respectively. Yet distinguishing these two different types of overachievement can be methodologically very challenging, as it could require the determination of the GHG emissions impact of individual circumstances and policies. In the political context of the Paris Agreement, moreover, this could also be politically very difficult.

The definition of hot air is tightly connected to the definition of environmental integrity. In this paper, we define hot air as existing when a country's NDC target is less stringent than its BAU emissions. In such cases, the country does not need to take mitigation action beyond existing policies in order to achieve its target. The volume of hot air is, then, the difference between BAU emissions projections and the emissions level of the NDC target (Figure 2).

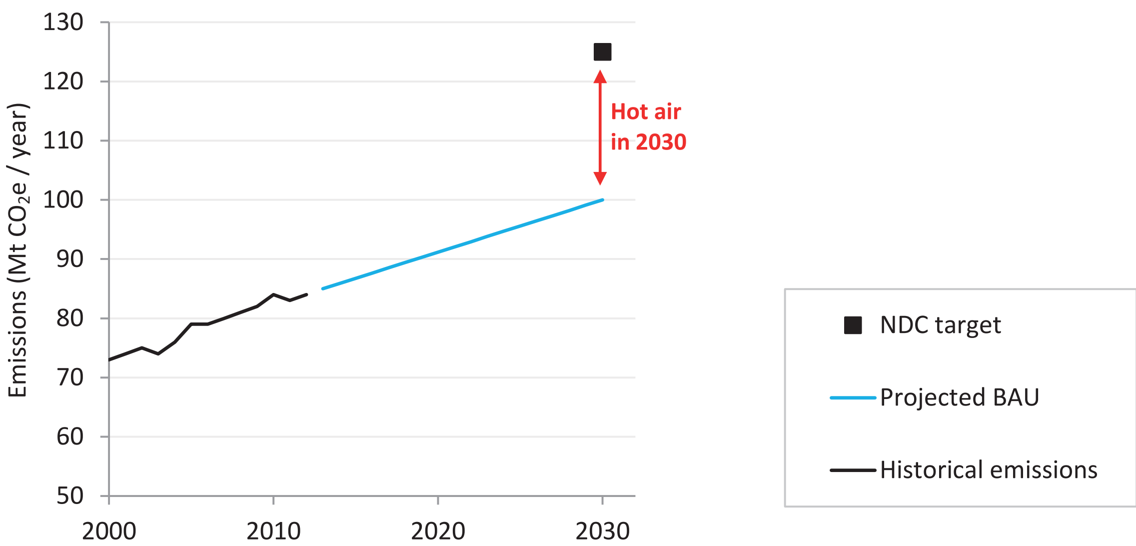

Figure 2: Definition of hot air

By relying on a comparison between the NDC target and BAU emissions projections, this definition is, however, subject to (a) challenges in interpreting NDC targets (as explored in Section 3.1) and (b) uncertainties in the establishment of BAU projections (as detailed in Section 3.2). These limitations make it difficult to pinpoint with precision *whether* countries' targets are more stringent than BAU, and *how much* hot air is contained in NDCs – as elaborated in Section 3.4 below.

An important element is related to the timing of any hot air assessment and the treatment of changing circumstances. This is relevant both in the context of changes in underlying assumptions (such as in technological development and international fuel prices), as well as in the context of unforeseen events (such as natural catastrophes and economic crises) that affect emission pathways. Whether or not these developments are understood to generate "hot air" depends on how BAU is defined and updated – as explored in Section 3.2. Throughout this paper, hot air is understood as the difference between the country's NDC target and BAU emissions projections established at the time of setting the target.

In the absence of international transfers, a country with hot air does not have to reduce emissions to achieve its target. The environmental consequences are the same as when the country would not have a mitigation target. If the country, however, engages in international transfers, hot air poses two key risks to environmental integrity:

1. **Higher global GHG emissions under current NDC targets**: As outlined in Section 2.3, if the transferring country has an NDC target less stringent than BAU (i.e. if the NDC target contains hot air), then ITMO transfers can lead to an increase in global GHG emissions. This risk applies to two types of international transfers:

   a. ITMO transfers that are backed by a mechanism but the mechanism does not ensure unit quality; and

   b. ITMO transfers that are not backed by a mechanism and hot air is transferred to other countries.

2. **Perverse incentives for future mitigation ambition**: As highlighted in Section 2.2, participation in international transfers could create perverse incentives for transferring countries to adopt less ambitious future NDC targets. If countries can accrue benefits from international transfers even where the ITMOs transferred are not backed by abatement action, then countries could have an incentive to establish future NDC targets at levels less stringent than BAU in order to transfer more ITMOs.

Provisions for **carry-over** bring additional risks, as they could enable hot air from one contribution period to be carried-over to later contribution periods – thereby reducing mitigation action and creating environmental integrity risks from international transfers in future periods.

3.4 Comparing current NDC targets with BAU emissions projections

In this section, we compare current NDC targets with independent BAU emissions projections with the objective of understanding the degree of environmental integrity risk posed by countries with NDC targets less stringent than BAU. As highlighted above, it is important to stress that there are significant uncertainties in BAU emissions projections and challenges in interpreting NDC targets. The results can thus only serve as an indication of the overall risk.

This analysis is *not* an assessment of country-level NDC ambition; such an assessment would have to take into account equity and development considerations as well as other country circumstances (such as cost, availability, and feasibility of mitigation options). Here, we compare NDC targets and BAU projections with the sole purpose of understanding how material the risk of hot air is in international transfers under the Paris Agreement.

3.4.1 Methodology and data sources

BAU emissions projections have been prepared as part of the NDC & INDC factsheets by Meinshausen and Alexander (2016) and the analyses by the Climate Action Tracker (CAT) project (Climate Action Tracker 2015). These two data sources are used here.

Meinshausen and Alexander (2016) provide BAU emissions projections on the basis of regional data from IPCC scenarios for distinct single years (2020, 2025 and 2030). The data includes target trajectories that are built on the basis of linear interpolation between historical emissions or previous targets and the NDC target. Targets are further differentiated between an upper and lower level, e.g. where countries put forward target ranges or conditional and unconditional targets. Data is provided for all but 17 countries. The Climate Action Tracker data includes G20 countries, as well as a few other countries. In contrast to data by Meinshausen and Alexander, Climate Action Tracker takes into account country-level information when estimating BAU emissions. The CAT data includes trajectories of BAU emissions, but NDC target levels are presented only for the target years communicated by the countries.

We use both data sources for the 29 countries that were analysed by Climate Action Tracker (2015), which are estimated to represent 83% of global emissions in 2030. In addition, we illustrate the aggregated outcome for all countries in Meinshausen and Alexander (2016) for which BAU projections are available, except for 20 countries with 2030 emissions well below 1 Mt-CO_2e. We end up with 131 NDCs, which account for 99% of projected emissions in 2030.

Most countries have communicated NDC targets only for a single year, mostly 2025 or 2030. Since the overall environmental impact depends on *cumulative* GHG emissions, we conduct the analysis not only for these single target years but also for the period from 2021 to 2030.

In order to compare NDC targets with BAU emissions projections for the period 2021 to 2030, we establish a hypothetical multi-year target trajectory for that period for each country. For the data from Meinshausen and Alexander, we linearly interpolate between the three data points for the target trajectory (2020, 2025 and 2030). For the data from Climate Action Tracker, we draw upon the approach that is used by Meinshausen and Alexander: for countries that have commitments in the second commitment period of the Kyoto Protocol or that have communicated targets in the context of the Cancun pledges for the year 2020, we assume a linear trajectory from the country's 2020 target to the NDC target for 2030; for countries without targets in the period up to 2020, we assume a linear emissions trajectory from the latest available historical emissions data and the target level in 2030.

We aim to use BAU emissions projections that were conducted at the time when the NDC targets were formulated by countries – in line with the definition of hot air proposed in Section 3.3 above. For Climate Action Tracker, we use the 2015 data. For the data by Meinshausen and Alexander, we use the version published on November 2016 which employs IPCC scenarios that were conducted before NDC targets were established.

An important consideration for the analysis is that neither BAU emissions projections nor NDC targets represent a single value, but rather a range. BAU emissions projections are uncertain and depend on the methods used and assumptions made (see Section 3.2). Climate Action Tracker reflects this uncertainty by providing a range for the projected BAU emissions for some countries, while a single estimate is provided for other countries. Meinshausen and Alexander only derive one BAU emissions scenario from regional IPCC projections. However, for some countries, Meinshausen and Alexander provide additional projections conducted in other studies. Similar to BAU emissions projections, many NDCs may also not be well represented by a single target level. While some countries have communicated only one NDC target, many countries have communicated different types of targets or different target levels, as well as conditional and unconditional targets. Moreover, for some NDCs it is unclear which sectors or gases are covered or how LULUCF will be accounted for. Lastly, it is unclear which of the targets or target levels will be used when accounting for the international transfer of ITMOs.

We reflect this uncertainty by defining two scenarios:

- In a **high mitigation scenario**, we compare the lowest GHG emissions level among the country's NDC targets with the *highest GHG emissions level* from the range of BAU emissions projections. This scenario thus represents the highest mitigation effort.

- In a **low mitigation scenario**, we compare the highest GHG emissions level among the country's NDC targets with the *lowest GHG emissions level* from the range of the BAU emissions projections. This scenario thus represents the lowest mitigation effort.

This approach aims to reflect the possible range of the emission reductions vis à vis BAU. The high mitigation scenario is rather optimistic since it combines the lowest NDC target level with the higher end of BAU emission estimates. The low mitigation scenario reflects the most conservative estimate of the potential emission reductions that can be achieved.

Figure 3 illustrates a situation where both the upper and the lower NDC target level are below the range of the projected BAU emission levels. In this example, the NDC is thus consistently more stringent than BAU emissions projections such that both the high and the low mitigation scenarios represent reductions from BAU.

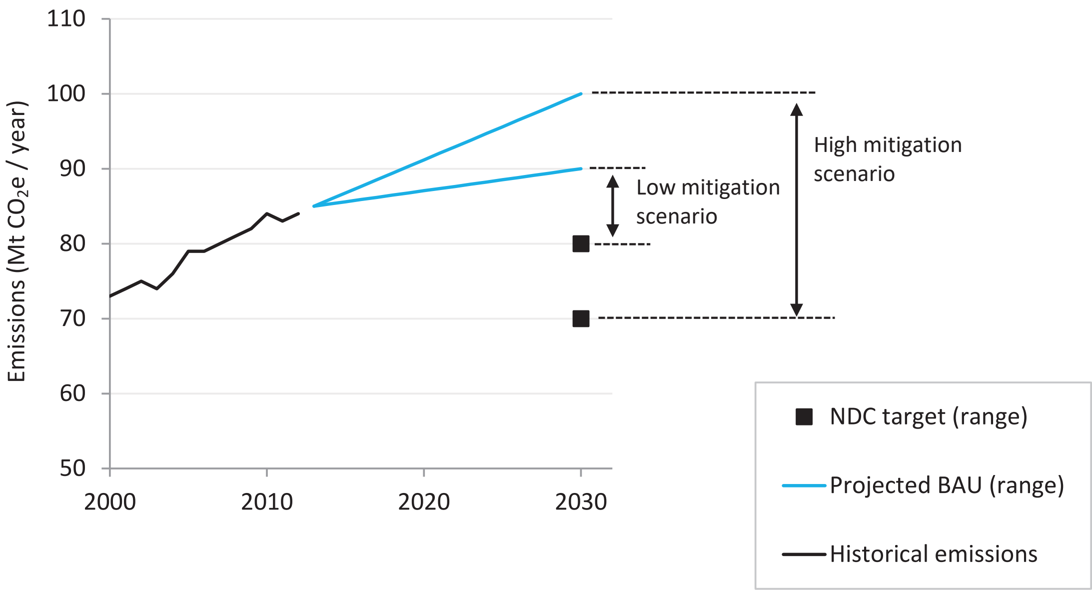

Figure 3: Mitigation scenarios with both upper and lower NDC targets more stringent than the BAU range

Figure 4 illustrates a situation where the BAU emissions projections and the NDC target levels partially overlap. In this case, the high mitigation scenario represents a reduction from BAU. In the low mitigation scenario, however, the NDC target is less stringent than the BAU projection – and the country has thus hot air, where hot air is understood as the difference between BAU emissions projections and the NDC target, such that the country does not need to take mitigation action beyond existing policies in order to achieve its target.

3.4.2 Discussion of results

The analysis is conducted for the single targets years 2025 and 2030, as well as for the 2021-2030 period as a whole. The results are discussed separately below.

3.4.2.1 Results for the years 2025 and 2030

Table 2 shows the results of the two scenarios for the two data sources, for the single target years 2025 and 2030. The individual countries included in the table are those for which an assessment by Climate Action Tracker was available as of 2015.[3] The table includes, in addition, the aggregated global impact for all countries based on Meinshausen and Alexander (2016).

3 For the purpose of this analysis, the European Union – comprised of 28 member states – is treated as a single "country".

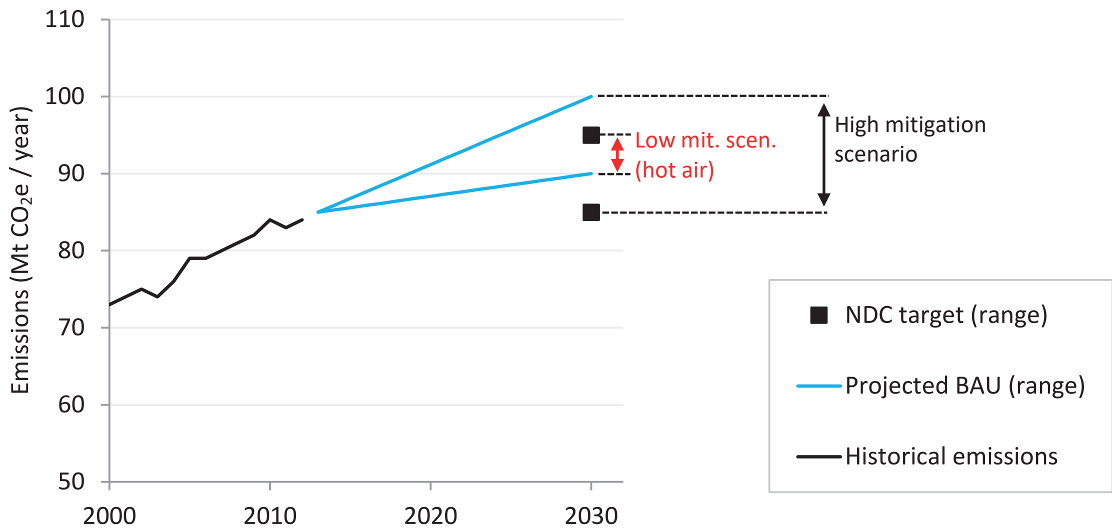

Figure 4: Mitigation scenarios with partially overlapping NDC and BAU ranges

Table 2 shows that the pledged mitigation – and the amount of hot air – vary strongly between the two scenarios, between the two data sources, and among the assessed countries. Overall, the potential for hot air in current NDC targets – based on the datasets we consulted – is significant, ranging from a total of 0.4 to 5.4 $GtCO_2e$ for the analysed countries in 2030.

In the high mitigation scenario, the total mitigation clearly exceeds the amount of hot air under both data sets. In the low mitigation scenario, by contrast, among the countries for which data by Climate Action Tracker is available, the potential for hot air is more than 5 $GtCO_2e$ – nearly three times the mitigation pledged by countries with NDC targets more stringent than BAU.

The data from Meinshausen and Alexander points to a large potential volume of hot air from countries not assessed by Climate Action Tracker (see Table 2, "131 NDCs in 2030"). In the high mitigation scenario, the total aggregate potential volume of hot air is estimated at more than 2 $GtCO_2e$, representing 20% of the total pledged mitigation from countries with NDC targets more stringent than BAU. In the low mitigation scenario, the hot air volume increases to more than 3 $GtCO_2e$, representing 60% of the pledged mitigation in that year.

The countries estimated to have hot air vary across the datasets. Calculations based on the Climate Action Tracker data indicate that between 2 and 6 out of the 28 countries with 2030 NDC targets in Table 2 have hot air. Data from Meinshausen and Alexander indicates that among 131 NDCs, 47 NDCs in the high mitigation scenario and 68 NDCs in the low mitigation scenario could have hot air – meaning that hot air in 2030 could stem from 36% to 52% of the NDCs assessed.

Table 2 also illustrates that the pledged mitigation – and the amount of hot air – varies strongly between data sources and scenarios.

- **Variation between data sources**: Among the 29 countries for which both data sources were available, 18 have NDC targets that are more stringent than BAU emissions in all scenarios and under both data sources. For some countries, the results vary considerably between the two data sources. This is owed to both differences in BAU emissions projections and lack of clarity of NDC targets, in particular with regard to accounting for LULUCF.[4] Understanding differences across data sources provides valuable insights into the difficulties of assessing the BAU emissions and understanding NDC targets:

4 The results differ also with respect to similar calculations carried out by den Elzen et al. (2016), according to which, for example, China has no hot air whereas Saudi Arabia does.

Table 2: Pledged mitigation in single target years 2025 and 2030, relative to independent BAU emission projections

		Climate Action Tracker				Meinshausen and Alexander			
		High mitigation scenario		Low mitigation scenario		High mitigation scenario		Low mitigation scenario	
		$MtCO_2e$	% of BAU emissions	$MtCO_2e$	% of BAU emissions	$MtCO_2e$	% of BAU emissions	$MtCO_2e$	% of BAU emissions
NDCs with 2025 targets	Brazil	-50	-4%	-40	-3%	-53	-4%	-53	-4%
	Gambia	-1	-43%	-0	-2%	-1	-36%	-0	-3%
	South Africa	-420	-50%	-204	-24%	-327	-44%	-111	-15%
	United States	-1,820	-27%	-1,169	-18%	118	2%	263	4%
	Total mitigation	-2,291	-26%	-1,413	-16%	-381	-5%	-164	-2%
	Total "hot air"	0	0%	0	0%	118	1%	263	3%
NDCs with 2030 targets	Argentina	-168	-28%	102	24%	-119	-27%	-48	-11%
	Australia	-255	-38%	-243	-36%	-182	-29%	-170	-27%
	Brazil	-80	-6%	-62	-5%	-170	-13%	-170	-13%
	Canada	-163	-20%	-163	-20%	-58	-7%	-15	-2%
	Chile	-40	-24%	-1	0%	-28	-20%	3	2%
	China	-848	-6%	3,634	27%	-3,003	-17%	-1,503	-8%
	Costa Rica	-9	-41%	-9	-41%	-10	-53%	-10	-53%
	Ethiopia	-125	-40%	-125	-40%	-20	-11%	-14	-8%
	EU28	-937	-22%	-91	-2%	-578	-14%	-578	-14%
	Gambia	-2	-45%	0	-1%	-1	-40%	-0	-10%
	Indonesia	109	10%	352	32%	-285	-25%	52	5%
	India	-153	-3%	723	13%	-1,764	-27%	-281	-4%
	Japan	-192	-15%	-66	-6%	-239	-19%	-239	-19%
	Kazakhstan	-203	-41%	-121	-27%	-93	-25%	-56	-15%
	Mexico	-308	-35%	-105	-13%	-498	-48%	-361	-35%
	Morocco	-54	-32%	-22	-13%	-9	-7%	27	22%
	New Zealand	-31	-37%	-31	-37%	-17	-20%	-17	-20%
	Norway	-32	-62%	-22	-42%	-33	-53%	-33	-53%
	Peru	-42	-30%	-18	-13%	-87	-63%	-57	-41%
	Philippines	-250	-72%	-209	-68%	-76	-35%	0	0%
	Russia	332	13%	539	21%	540	23%	709	31%
	Ukraine	-220	-28%	23	4%	79	16%	79	16%
	Saudi Arabia	-313	-27%	-49	-4%	-128	-13%	0	0%
	Singapore	-9	-12%	-9	-12%	-9	-10%	20	22%
	South Africa	-527	-56%	-311	-33%	-409	-49%	-193	-23%
	South Korea	-260	-33%	-133	-20%	-526	-50%	-526	-50%
	Switzerland	-13	-34%	-13	-34%	-36	-57%	-36	-57%
	Turkey	-231	-20%	-65	-7%	386	82%	386	82%
	Total mitigation	-5,465	-14%	-1,867	-5%	-8,376	-19%	-4,306	-10%
	Total "hot air"	441	1%	5,373	14%	1,006	2%	1,278	3%
131 NDCs in 2030	Total mitigation	NA	NA	NA	NA	-10,262	-18%	-5,535	-10%
	Total "hot air"	NA	NA	NA	NA	2,080	4%	3,312	6%

Table 2 Source: Calculations based on data from Climate Action Tracker (2015) and from Meinshausen and Alexander (2016). In aggregate, the 29 individual countries included in the table represent 83% of global GHG emissions in 2030. The 131 NDCs based on data by Meinshausen and Alexander represent 99% of global emissions in 2030. Negative (green) values indicate that the NDC is more stringent than projected BAU emissions. Positive (red) values indicate that that the NDC is target is less stringent than projected BAU emissions. Black values indicate circumstances where the volume of mitigation or hot air correspond to less than 1% of BAU emissions. For totals, the "mitigation outcome relative to BAU" is calculated based on the BAU emission level of all countries (including those with targets more stringent and less stringent than BAU). Totals for 2030 do not include 2025 figures. World totals include projected NDC values for the United States in line with an emission reduction pathway of 80% below 2020 by 2050, as per the U.S. NDC.

- In the case of China, the BAU emissions projections vary considerably between data from Climate Action Tracker and from Meinshausen and Alexander. Climate Action Tracker estimates BAU emissions in the range of 13.6-16.9 $GtCO_2e$ in 2030 – which itself is already a significant range – whereas Meinshausen and Alexander derive a BAU emissions scenario of 18.5 $GtCO_2e$.

- In the case of the United States, both the target level and the BAU emissions projections differ between the two data sources. The United States communicated a target of reducing emissions by 26-28% below 2005 levels in 2025. However, there is uncertainty surrounding the projected removals from LULUCF. Meinshausen and Alexander estimate these to be significantly larger than Climate Action Tracker, leading to a difference in the target level without LULUCF of 14-22%. The direction of the difference is opposite for BAU emissions projections: here Meinshausen and Alexander estimate BAU emissions to lie at 6.1 $GtCO_2e$ in 2025, whereas Climate Action Tracker estimates them at 6.7 to 6.8 $GtCO_2e$. These differences across the datasets result in a large deviation of the overall assessment of the pledged mitigation: Climate Action Tracker estimates the target to be in both scenarios significantly below BAU emissions, whereas Meinshausen and Alexander estimate it to be in both scenarios significantly above BAU emissions projections.

• **Variation between scenarios**: The pledged mitigation and the amount of hot air differ strongly between the high and low mitigation scenarios:

  - In the **high mitigation scenario**, most of the countries displayed in Table 2 have NDC targets that are more stringent than their projected BAU emissions, and only a few countries have hot air. The total mitigation from countries with NDC targets more stringent than BAU is estimated at 5.5 $GtCO_2e$ using data from Climate Action Tracker and 8.4 $GtCO_2e$ using data from Meinshausen and Alexander, corresponding to a reduction of about 15% or 19% compared to the high BAU emissions projection respectively. The amount of hot air from countries with NDC targets less stringent than BAU amounts to 0.4 $GtCO_2e$ using data from CAT and 1 $GtCO_2e$ using data from Meinshausen and Alexander, corresponding to about 8% (CAT) or 12% (Meinshausen and Alexander) of total mitigation.

  - In the **low mitigation scenario**, the number of countries with hot air in Table 2 is larger. For the Climate Action Tracker data, the amount of hot air increases more than ten-fold – by about 5 $GtCO_2e$ – as compared to the high mitigation scenario. For the Meinshausen and Alexander data, the increase is much smaller, at about 0.3 $GtCO_2e$. Based on the Climate Action Tracker data, the amount of hot air exceeds the overall pledged mitigation from NDC targets that are more stringent than BAU. Data by Meinshausen and Alexander does not display this effect. One of the reasons for this important difference is that Climate Action Tracker uses a range for the projected BAU emissions, whereas Meinshausen and Alexander derive a single estimate from regional and gas-specific IPCC scenarios; a range of BAU emissions results in larger differences between the low and high mitigation scenarios.

3.4.2.2 Results for the period 2021-2030

Similar results can be observed from the analysis for the period 2021 to 2030, as shown in Table 3. Here also the volume of hot air is estimated to be significant: in the global figures based on Meinshausen and Alexander, the hot air volume could amount to between 23% and 67% of the pledged mitigation in the high and low mitigation scenarios respectively. Overall, calculations based on Meinshausen and Alexander indicate that between 38% and 56% of the 131 NDCs considered could have aggregate hot air in the 2021-2030 period.

For some countries, the results differ between the single target years (Table 2) and the period from 2021 to 2030 (Table 3). Some countries were estimated to have NDC targets more stringent than BAU in the single target years, but were found to have hot air in the aggregate calculations for the 2021-2030 period. This occurs because the BAU and the NDC trajectories intersect during the 2021-2030 period, such that the relationship between them changes over time.

It is also important to highlight that the methods to establish the trajectory are a key determinant factor for the volume of hot air for the 2021–2030 period. The calculations presented in Table 3 are based on linear NDC trajectories between countries' 2020 targets (or more recent historical emissions) and the NDC. Trajectories drawn between actual emissions in 2020 and the NDC targets, for example, could produce different results.

Table 3: Cumulative pledged mitigation over the period 2021 to 2030, relative to independent BAU emission projections

	Climate Action Tracker				Meinshausen and Alexander			
	High mitigation scenario		Low mitigation scenario		High mitigation scenario		Low mitigation scenario	
	$MtCO_2e$	% of BAU emissions	$MtCO_2e$	% of BAU emissions	$MtCO_2e$	% of BAU emissions	$MtCO_2e$	% of BAU emissions
Argentina	-1,260	-24%	769	19%	-642	-16%	-324	-8%
Australia	-2,132	-34%	-1,566	-25%	-1,324	-22%	-1,258	-21%
Brazil	-915	-7%	-628	-5%	-276	-2%	-136	-1%
Canada	-1,441	-19%	-1,441	-19%	-934	-12%	596	7%
Chile	-305	-20%	-74	-5%	-197	-16%	25	2%
China	-1,814	-1%	24,433	19%	-25,154	-15%	-12,874	-8%
Costa Rica	-55	-29%	-55	-29%	-79	-44%	-79	-44%
Ethiopia	-999	-38%	-999	-38%	-146	-9%	-102	-6%
EU28	-4,562	-11%	1,258	3%	-2,545	-6%	-2,545	-6%
Gambia	-13	-39%	0	0%	-11	-35%	-3	-9%
Indonesia	768	8%	2,104	22%	-4,748	-46%	-1,709	-17%
India	-834	-2%	5,102	11%	-14,203	-24%	-4,505	-8%
Japan	-935	-7%	200	2%	-1,283	-10%	-1,283	-10%
Kazakhstan	-1,436	-33%	-949	-24%	-846	-23%	-640	-18%
Mexico	-2,472	-29%	-1,290	-16%	-4,306	-46%	-2,484	-27%
Morocco	-379	-26%	-138	-9%	-62	-6%	199	18%
New Zealand	-268	-32%	-268	-32%	-142	-17%	-115	-14%
Norway	-264	-50%	-206	-39%	-290	-46%	-290	-46%
Peru	-323	-26%	-153	-12%	-648	-51%	-436	-34%
Philippines	-2,375	-68%	-1,540	-58%	-501	-25%	20	1%
Russia	2,140	8%	3,458	14%	4,486	18%	5,418	22%
Ukraine	-151	-2%	1,379	28%	1,583	33%	1,583	33%
Saudi Arabia	-2,426	-24%	-380	-4%	-903	-10%	17	0%
Singapore	1	0%	32	5%	-75	-9%	107	13%
South Africa	-4,303	-51%	-2,205	-26%	-3,366	-45%	-1,294	-17%
South Korea	-2,504	-32%	-1,524	-22%	-4,153	-44%	-4,153	-44%
Switzerland	-120	-28%	-96	-22%	-276	-45%	-276	-45%
Turkey	-1,472	-16%	-213	-3%	2,616	57%	2,642	57%
Total mitigation	-33,756	-9%	-13,724	-4%	-67,110	-16%	-34,505	-8%
Total "hot air"	2,908	1%	38,735	11%	8,685	2%	10,606	3%
Total mitigation (131 NDCs)	NA	NA	NA	NA	-80,298	-15%	-42,238	-8%
Total "hot air" (131 NDCs)	NA	NA	NA	NA	18,731	3%	28,312	5%

Source: Calculations based on 2015 data from Climate Action Tracker (2015) and from Meinshausen and Alexander (2016). In aggregate, the individual countries included in the table represent 74% of global GHG emissions in 2030. The 131 NDCs based on data by Meinshausen and Alexander represent 99% of global emissions in 2030. Negative (green) values indicate that the NDC is more stringent than projected BAU emissions. Positive (red) values indicate that the NDC target is less stringent than projected BAU emissions. Black values indicate circumstances where the volume of mitigation or hot air correspond to less than 1% of BAU emissions. For totals, the "mitigation outcome relative to BAU" is calculated based on the BAU emission level of all countries (including those with targets more stringent and less stringent than BAU). Totals include projected NDC values for the United States in line with an emission reduction pathway of 80% below 2020 by 2050, as per the U.S. NDC.

3.4.2.3 Overall assessment

Important conclusions can be drawn from this analysis. A first key conclusion is that the assessment of the pledged mitigation– and the amount of hot air – varies strongly (Table 4). The analysis above shows that the assessment strongly hinges on two factors: (a) the assumptions and the uncertainty in establishing BAU emissions projections; and (b) the clarity and interpretation of mitigation targets, including (i) their trajectory, (ii) understanding which of several communicated target levels will ultimately be achieved by the countries (and used for accounting purposes), and (iii) how LULUCF is accounted for. The outcome is sensitive to the underlying assumptions and scenarios, which also makes it difficult to assess whether and how much hot air may be present under current NDC targets.

Variations notwithstanding, the results based on the two datasets point to a large potential for hot air in current NDCs. Global aggregate calculations based on data by Meinshausen and Alexander indicate that the potential volume of hot air is significant even in the high mitigation scenario. This potential hot air volume, moreover, is not restricted to a few countries only; according to calculations based on data by Meinshausen and Alexander, between 36% and 56% of the 131 NDCs considered could have hot air. According to the analysis based on Climate Action Tracker data, the number of NDC targets that are estimated to have hot air varies between 7% and 32%, depending on the scenario and period considered (see Table 4). Furthermore, no particular commonalities could be identified across countries that are estimated to have hot air. These figures indicate that the potential for hot air in current NDC targets could be a significant threat to mitigation under the Paris Agreement.

Table 4: Hot air volume and number of countries with hot air, across data sources and periods, based on independent BAU emission projections

			Climate Action Tracker (28 NDCs)		Meinshausen and Alexander (28 NDCs)		Meinshausen and Alexander (131 NDCs)	
			High mitigation scenario	Low mitigation scenario	High mitigation scenario	Low mitigation scenario	High mitigation scenario	Low mitigation scenario
Volume of hot air	In 2030	$GtCO_2e$	0.4	5.4	1.0	1.3	2.1	3.3
		Percentage of pledged mitigation	8%	288%	12%	30%	20%	60%
	2021-2030	$GtCO_2e$	2.9	38.7	8.7	10.6	18.7	28.3
		Percentage of pledged mitigation	9%	282%	13%	31%	23%	67%
No. of countries with hot air	In 2030	No. of countries	2 out of 28	6 out of 28	3 out of 28	7 out of 28	47 out of 131	68 out of 131
		Percentage of countries	7%	21%	11%	25%	36%	52%
	2021-2030	No. of countries	2 out of 28	9 out of 28	3 out of 28	7 out of 28	50 out of 131	73 out of 131
		Percentage of countries	7%	32%	11%	25%	38%	56%

Source: Calculations based on Climate Action Tracker (2015) and Meinshausen and Alexander (2016).

4 EXPERIENCE AND LESSONS LEARNED FROM THE KYOTO PROTOCOL

The Kyoto Protocol provides important lessons on the international transfer and carry-over of units from countries with mitigation targets less stringent than BAU. This experience may be valuable in addressing the risk of such transfers under the Paris Agreement. While the two regimes differ in key aspects, such as how mitigation targets are established, they also share important similarities, in particular that both treaties enable international transfers to take place and that the ambition of mitigation targets varies. In this section, we summarize the experience and lessons learned from the Kyoto Protocol and assess whether these lessons can be useful under the Paris Agreement – despite the differences across both regimes.

Under the Kyoto Protocol, a few countries – most notably economies in transition (EITs)[5] – had GHG targets that were less stringent than their likely BAU emissions (Boehringer et al. 2007), thus generating a surplus of AAUs. This AAU surplus is often referred to as "hot air"; the economic downturn in the early 1990s meant that those countries' mitigation targets, when adopted in 1997, were at the time already less stringent than their BAU emissions projections for the first commitment period from 2008 to 2012 (Victor et al. 1998).

Article 17 of the Kyoto Protocol allows Kyoto units to be internationally transferred between countries. Countries could either directly transfer AAUs, or approve projects under Joint Implementation and convert AAUs into emission reduction units (ERUs), which could then be transferred and used by other countries. In the first commitment period, countries with Kyoto targets less stringent than BAU internationally transferred about 450 million AAUs and issued about 840 million ERUs.[6] Overall, the international transfer of Kyoto units from countries with targets less stringent than BAU is deemed to have undermined the mitigation impact of the Kyoto Protocol in its first commitment period (Kollmuss et al. 2015).

The AAU surplus has been a contentious issue since the adoption of the Kyoto Protocol. While it is widely regarded as a threat to the environmental integrity of the regime, many regard it as an unavoidable part of the agreement. (Brandt and Svendsen 2004), for example, argue that the participation and the targets put forward by the U.S. and EITs were based on the understanding that there would be an internationally transferrable surplus. (Woerdman 2005), moreover, argues that in the absence of the possibility of trading such surplus, emission targets for countries under the Kyoto Protocol could have been less stringent, to an extent that might even have exceeded the surplus from EITs. Later, the withdrawal of the U.S. and Canada from the Protocol changed the original balance, leaving a large surplus of units (Klepper and Peterson 2005; Boehringer and Loeschel 2003). Analysis by (Shishlov et al. 2016) indicates that aggregate emissions of countries with targets inscribed in Annex B (i.e. including the US and Canada) were higher than their target levels – notwithstanding the AAU surplus from countries with Kyoto targets less stringent than BAU. This means that if the U.S. and Canada had stayed in the agreement, further mitigation action would have been necessary – either domestically or through the purchase of certified emission reductions (CERs) – even if the entire AAU surplus had been transferred internationally.

4.1 International unit transfers

The Kyoto Protocol and its Marrakesh Accords do not include provisions to address the risk of international transfers from countries with targets less stringent than BAU. However, joint implementation and Green Investment Schemes were used by countries to mitigate this risk, and the Doha Amendment to the Kyoto Protocol includes provisions in Article 3.7ter that attempt to address the risk for the second commitment period of the Protocol. Other Kyoto Protocol provisions,

5 The list of EITs under UNFCCC is available at: http://unfccc.int/not_assigned/b/items/2555.php

6 Calculations based on Tuerk et al. (2013) and (UNFCCC 2016), drawing on (Kollmuss et al. 2015) for the list of countries with targets less stringent than BAU.

such as the principle of supplementarity and the commitment period reserve, could potentially limit international unit transfers and thereby indirectly mitigate these risks.[7]

4.1.1 Joint implementation

Joint implementation (JI) is one of two crediting mechanisms under the Kyoto Protocol, along with the CDM. It enables countries with emission reduction commitments under the Kyoto Protocol to generate emission reduction units (ERUs) from mitigation projects and transfer them to other countries. JI operates in two tracks: Under Track 1, host countries can largely establish their own rules for approving projects and issuing ERUs, without international oversight. Under Track 2, a UN body – the Joint Implementation Supervisory Committee (JISC) – oversees the registration of projects and issuance of ERUs and accredits JI auditors. As of January 2016, 872 million ERUs had been issued under the mechanism: 847 million under Track 1 and 25 million under Track 2.

Faced with concerns about the integrity of international AAU transfers from countries with targets less stringent than BAU, some countries favored the use of JI – which was perceived as more environmentally sound – over transfers of AAUs (Grubb 2016). Under the EU ETS, for example, ERUs were eligible for compliance while AAUs were not.

ERUs are issued to projects that fall within the scope of targets under the Kyoto Protocol; the mechanism is designed such that the issuance of one ERU must lead to the cancellation of one AAU by the host country. Such a system could ensure the environmental integrity of transfers because host countries would have to compensate for units that lack quality in order to achieve their target; this, however, is only the case if host countries have ambitious mitigation targets (i.e., targets that are significantly below BAU emissions). More than 95% of ERUs were issued by countries with a significant surplus of AAUs in the first commitment period of the Kyoto Protocol (Kollmuss et al. 2015). In such cases, host countries could use the AAU surplus to generate ERUs – and therefore had no incentive to ensure the integrity of units transferred.

(Kollmuss et al. 2015) evaluated the environmental of JI projects and concluded that 73% of ERUs are unlikely to represent additional emission reductions. In the presence of targets less stringent than BAU, this leads to an increase in global GHG emissions: the authors estimate that the use of JI may have enabled global GHG emissions to be about 600 million tCO_2e higher than they would have been if countries had met their Kyoto targets domestically. The plausibility of environmental integrity varied strongly across the two JI tracks: under JI Track 2, which is subject to international oversight, environmental integrity risks were considerably lower than under Track 1. Units generated in countries with ambitious targets were found to have higher plausibility of quality.

This suggests that JI was not successful in mitigating the risk of transfers from countries with targets less stringent than BAU. A key lesson learned is that "having" a mechanism is not enough to ensure unit quality, as the effectiveness of the mechanism relies heavily on its design and the incentives of countries to ensure unit quality. The experience with JI confirms that the ambition of the mitigation target of the transferring country is critical for the incentives to ensure unit quality. The evaluation of JI also showed that international oversight can have an impact on unit quality. However, other studies also point to the inherent difficulties of ensuring unit quality under crediting mechanisms, even with international oversight (Dechezlepetre et al. 2014; Erickson et al. 2014; Haya and Parekh 2011; He and Morse 2013; Cames et al. 2016; Michaelowa and Purohit 2007; Purdon 2014; Schneider 2009; Spalding-Fecher et al. 2012).

(Kollmuss et al. 2015) draw several conclusions for the design of future crediting mechanisms, all of which are relevant for Article 6:

7 Eligibility criteria for engaging in international transfers, although employed under the Kyoto Protocol, did not address issues of unit quality or ambition and are thus not relevant here

- **Transparency of key project documentation**: Lack of transparency was an important concern in some JI host countries, where key project documentation was not available or incomplete for a number of projects. Rules and enforcement are needed in crediting mechanisms to ensure timely and complete reporting. The authors highlight, however, that transparency – although crucial for ensuring environmental integrity – is not sufficient by itself: according to the authors, Ukraine ensured a high degree of transparency but nevertheless issued mostly ERUs of very questionable quality.

- **Only internationally accepted methodologies should be eligible for use**: JI allowed projects to apply their own approaches for additionality demonstration and the calculation of emission reductions. In many cases this entailed inappropriate approaches and unrealistic assumptions, often leading to significant over-crediting. (Kollmuss et al. 2015) recommend that mechanisms use only internationally accepted methodologies that have undergone thorough review by experts and were developed for specific and defined project types.

- **Accountability of auditors for all activities they undertake**: Accredited Independent Entities (AIEs) under JI have the key role of ensuring the compliance of the projects with JI requirements, including those related to environmental integrity. In many cases, they did not perform their auditing functions appropriately. This was especially the case under JI Track 1, where the performance of AIEs was not monitored and non-performance had no consequences. (Kollmuss et al. 2015) recommend that crediting mechanisms adopt accreditation systems which continuously monitor the performance of auditors and which apply sanctions in the case of non-performance.

- **Retroactive crediting**: JI rules allowed projects to issue ERUs for emission reductions that took place before the project was registered, and a significant portion of ERUs were issued through retroactive crediting. (Kollmuss et al. 2015) noted that for many projects, there was a significant time gap between project start and JI approval, leading to serious questions about the additionality of these projects. (Kollmuss et al. 2015) recommend that retroactive crediting be avoided in future crediting mechanisms.

- **Investors should have reasonable certainty**: In several JI host countries, project developers faced considerable uncertainty as to whether their projects would ultimately be approved and ERUs issued. (Kollmuss et al. 2015) note that this uncertain environment may have favoured projects that did not rely on ERU revenues, thereby also negatively affecting the overall quality of the project portfolio. The authors recommend establishing a stable and predictable regulatory environment for crediting mechanisms.

4.1.2 Green Investment Schemes

As a result of environmental integrity concerns about AAU transfers from countries with targets less stringent than BAU, some buyer countries under the Kyoto Protocol were initially reluctant to purchase said units (Grubb et al. 2011). Green Investment Schemes (GISs) were developed by some countries to address this concern: GISs aimed to invest revenues from the sales of AAUs in climate change mitigation, thereby alleviating environmental integrity risks. A GIS does not prevent the transfer of units that lack quality; rather, it aims to (partially) compensate for it by investing revenues into mitigation action. Emission reductions may be achieved after the financial transaction, to the extent that the revenues – if and once invested – lead to emission reductions.

International rules for GISs do not exist. The schemes were established in the context of international emissions trading under Article 17 of the Kyoto Protocol. Bilateral agreements between transferring and acquiring countries established the conditions of the international transfer of AAUs and also addressed how the revenues were to be invested. In a review of the AAU market between 2008 and 2012, (Tuerk et al. 2013) note that GISs enabled countries to promote emission reductions that could not be easily addressed by JI, such as energy efficiency in buildings, mitigation measures in the transport sector and the transfer of certain technologies. Yet the GHG impact of the schemes was questionable, due to three main factors:

1. **Additionality**: While several countries avoided overlap between GIS funds and existing national support programmes in order to promote additionality, (Tuerk et al. 2013) highlight that additionality criteria under GISs were typically less stringent than under CDM or JI. Moreover, in market conditions of low AAU prices, the additionality of GIS investments seemed unlikely, as GIS revenues often covered only a small fraction of the total investment costs.

2. **Quantification of emission reductions**: Challenges with the quantification of emission reductions related to two main aspects:

   - *Type of greening*: (Tuerk et al. 2013) observe that in the first years of GISs, investments focused on easy-to-calculate and direct emission reductions, known as “hard greening”,[8] such as renewable energy and energy efficiency projects. Yet over time, countries targeted more indirect and long-term measures, or “soft greening”, such as capacity building and technology development. The quantifiability of emission reductions lost prominence over time, giving way to other, less quantifiable criteria, such as the replication potential and early implementation of low carbon technologies.

   - *Monitoring, reporting and verification*: Although countries typically proposed mechanisms to implement, monitor and verify AAU revenue flows and resulting emission reductions, (Tuerk et al. 2013) highlight that some of these mechanisms were not put into place. In fact, for some transactions there was no assurance of investment of revenues, let alone any monitoring of results. The schemes also differed in their approach to the timing of emission reductions: some calculated emission reductions within the relevant commitment period of the Kyoto Protocol, whereas others employed longer timeframes.

3. **Greening ratio**: The greening ratio describes the relation between the amount of AAUs sold and the emission reduction achieved; for example, if activities funded with the revenues of 10 AAUs led to an emission reduction of 5 tons CO_2e, then the greening ratio is 0.5. (Tuerk et al. 2013) note that attempts to ensure a high greening ratio lost prominence for acquiring countries over time, and that the market saw deals with low prices and high AAU volumes where only small amounts of reductions were foreseen. (Tuerk et al. 2013) observe a continuum from AAU trades with significant emission reductions to deals with marginal direct reductions: the absence of an internationally agreed definition of “greening” made it difficult to ensure that actual emission reductions occurred. Overall, it is likely that AAU transfers under GISs had, on average, a greening ratio of far below one.

Overall, GISs were ineffective in addressing the risk of transfers from countries with targets less stringent than BAU under the Kyoto Protocol, and transfers led to an increase in global GHG emissions compared to a situation where countries achieved their targets domestically.

Ensuring environmental integrity for GISs would require the same elements as necessary for ensuring the environmental integrity of crediting schemes: ensuring additionality, ensuring that emission reductions are equal to or exceed the amount of units transferred (i.e. a greening ratio of at least 1), and addressing any non-permanence. A key difficulty in the case of GISs is that emission reductions happen in the transferring country only after the transfer takes place, such that there is little incentive from either the acquiring or transferring countries to ensure the integrity of the transaction.

8 Hard greening refers to activities in which the scheme delivers direct measurable and quantifiable emission reductions, such as investments in renewable energy and retrofitting of buildings. Soft greening occurs if the corresponding activities have non-quantifiable and non-measurable emission reductions, such as environmental education and subsidy reform.

Another takeaway from the experience with GISs is that in a situation of oversupply of surplus units, the needs and interests of acquiring countries play a central role in ensuring environmental integrity – both in terms of defining the terms of the transfer, and in terms of ensuring the ex post realization of emission reductions. The findings of (Tuerk et al. 2013), however, indicate that initial motivations to ensure environmental integrity waned significantly amongst acquiring countries over time. A similar situation could take place under the Paris Agreement.

4.1.3 Supplementarity and commitment period reserve

The Kyoto Protocol established two provisions that could impact the number of units internationally transferred in a commitment period: the principle of supplementarity and the commitment period reserve. These provisions were not established to prevent transfers from countries with targets less stringent than BAU. They could, however, affect the number of units transferred and thereby *limit* detrimental effects from such transfers generally.

The principle of **supplementarity** requires that "the use of the mechanisms shall be supplemental to domestic actions and that domestic action shall thus constitute a significant element of the effort made by each [Annex I Party] to meet its [commitments]" (decision 2/CMP.1, paragraph 1). It was thus introduced to prioritize domestic action (Yamin and Depledge 2004). Supplementarity is commonly understood to mean that a certain proportion of the emission reductions must be achieved domestically, and the remainder can be achieved through the acquisition of international units. However, the principle has not been operationalized under the Kyoto Protocol. Even if it had been operationalized – such as by requesting that half of the emission reductions be achieved domestically – the transferrable volume under this provision would have been large enough that it would not have acted as a limitation with regards to transfers from countries with targets less stringent than BAU.

The **commitment period reserve (CPR)** was introduced to prevent the over-selling of units. It limits the number of units that countries with emission reduction commitments can transfer to other countries, by requiring that each Party maintain a reserve of units covering at least 90% of the Party's assigned amount or five times its most recently reviewed GHG inventory emissions, whichever is lowest (UNFCCC 2005: Annex, paragraph 6). The CPR was operationalized through relevant provisions in the International Transaction Log (ITL) which controls the unit transfers between national registries. However, the limit does not provide safeguards with regard to the environmental integrity risks of unit transfers from countries with targets less stringent than BAU, as the minimum reserve based on GHG inventory emissions left nearly all the AAUs surplus available for international transfers.

In conclusion, neither of these two approaches specifically aimed to address the environmental risks of transfers from countries with targets less stringent than BAU, and neither of them effectively address this risk.

4.1.4 Article 3.7ter of the Doha Amendment

While the Kyoto Protocol did not include rules to address the environmental risks of international unit transfers from countries with targets less stringent than BAU, the Doha Amendment to the Kyoto Protocol includes a provision that aims to address this risk. Article 3.7ter amends the provisions governing the calculation of assigned amount units (AAUs) as follows: "*Any positive difference between the assigned amount of the second commitment period for a Party included in the Annex I and average annual emissions for the first three years of the preceding commitment period multiplied by eight shall be transferred to the cancellation account of that Party.*" (UNFCCC 2012: Annex I, Article G). Article 3.7ter in effect ensures that the permitted average annual emissions of an Annex I Party with a quantified target in the second commitment period of the Kyoto

Protocol – i.e. the amount a country can emit as a result of its adjusted assigned amount – cannot exceed that Party's average annual emission levels over the period 2008–2010. This provision, hence, effectively places a minimum level of ambition for second commitment period targets, by using the reported emissions for the period 2008 to 2010 as a reference level.

If the Doha Amendment were to come into force, this provision could, to a large extent, address the risk of transfers from countries with targets less stringent than BAU during the second commitment period (CP2).[9]

If a country has a CP2 target that is *less stringent* than its actual 2008 to 2010 emissions, then the country's assigned amount would be reduced to the average 2008 to 2010 emissions level. The extent to which this provision addresses the risk depends on the relationship between the country's 2008 to 2010 emissions and its BAU emissions during the second commitment period:

- If the country's CP2 BAU emissions lie above its 2008 to 2010 emissions, then the implementation of Article 3.7ter would in effect require the country to reduce its emissions below its BAU emissions level. This, in turn, would ensure environmental integrity, as the country would have to compensate for international transfers of units that lack quality.
- If the country's CP2 BAU emissions lie below its 2008 to 2010 emissions, then the risk would not be fully addressed: in this case, the surplus between the CP2 BAU emissions and the adjusted assigned amount would still be transferrable. The overall risk, however, is likely to be significantly lower than without the provisions of Article 3.7ter.

If a country has a CP2 target that is *more stringent* than its actual 2008 to 2010 emissions, then the provision of Article 3.7ter does not affect the country's assigned amount, yet some risk could remain. The extent of the risk depends on the relationship between the country's target and its BAU emissions during the second commitment period:

- If the country has a target that is more stringent than its BAU emissions, then international transfers do not constitute a risk to environmental integrity.
- If, however, the country has a target that is less stringent than its BAU emissions, then the surplus between BAU and the target would still be transferrable, and would thus constitute a risk to the environmental integrity of international transfers.

4.2 Carry-over of units

Article 3.13 of the Kyoto Protocol establishes that unused AAUs from one commitment period can be added to the subsequent commitment period. The provisions governing this carry-over of units are further specified in paragraphs 15 and 16 of decision 13/CMP.1. According to these provisions, each Party can carry-over an unrestricted amount of unused AAUs across commitment periods, whereas the carry-over of unused CERs and ERUs is limited to 2.5% of the assigned amount of the first commitment period of that Party.

The carry-over of surplus AAUs presented an important challenge in the negotiations of the Doha Amendment for the second commitment period of the Kyoto Protocol. In 2012, the AAU surplus from the first commitment period (CP1) was estimated at about 13 billion units (Point Carbon 2012); studies highlighted that a carry-over of this surplus would undermine mitigation targets of the second commitment period (CP2), as the CP1 surplus exceeds the emission reductions needed to achieve targets proposed for CP2 (den Elzen et al. 2010; World Bank 2013). Decision 1/CMP.8 adopting the Doha Amendment to the Kyoto Protocol contains two approaches to deal with the CP1 surplus: an amendment to the carry-over rules, and a political declaration by a number of countries.

9 Note that this may not apply to EIT countries who did not have targets under the first commitment period of the Kyoto Protocol, as per the provisions of Decision 2/CMP.11.

4.2.1 Doha carry-over rules

Decision 1/CMP.8, paragraphs 23 to 26, clarifies the rules governing the carry-over of units from CP1 to CP2, reiterating and complementing previous rules.[10] The Doha Amendment establishes for each Party a new, separate account – the Previous Period Surplus Reserve (PPSR) – with the aim of limiting the carry-over and international transfer of surplus AAUs from the first commitment period. Surplus AAUs from the first commitment period can no longer be carried over directly, but have to be moved to the PPSR. AAUs in the PPSR can be used for domestic compliance in CP2 only if CP2 emissions are higher than the country's CP2 target. International transfers of CP1 AAUs is possible, yet only across PPSRs and limited to 2% of the CP1 assigned amount of the purchasing Party.

The Doha approach to carry-over is an example of *limiting the use* rather than *eliminating the existence* of surplus units. Should the approach be implemented, the potential for damage by transfers from countries with targets less stringent than BAU would be reduced, although not entirely prevented. This is because countries with Kyoto targets less stringent than BAU in CP1 would still be able to transfer units from their PPSR to countries whose emissions are higher than their CP2 target. And the use of these units would lead to an increase in global GHG emissions as compared to a situation where CP2 targets were achieved domestically. However, the overall effect is limited by capping international transfers at 2% of the assigned amount of CP1.

Negotiations leading to the Doha Amendment faced resistance from some Parties, in particular Russia, Ukraine and Belarus (IISD 2012). Ukraine recorded the following footnote in the Doha Amendment with regards to its quantified emission limitation or reduction commitment for the second commitment period: "Should be full carry-over and there is no acceptance of any cancellation or any limitation on use of this legitimately acquired sovereign property." This reflects the difficulties some Parties have with the approach of limiting the carry-over of units, especially when the units are created up front and thus considered as sovereign property or national assets that ought to be preserved across periods.

4.2.2 Doha political declaration

Faced with a political deadlock in the negotiations on whether and how to deal with the carry-over of CP1 AAUs into CP2, a number of Parties (Australia, the EU, Japan, Liechtenstein, Monaco, Norway and Switzerland) put forward political declarations on the use of AAUs carried over from the CP1. In these declarations, which were included in Annex II of decision 1/CMP.8, countries commit to not purchasing or to not making use of AAUs that were carried over from CP1. These countries make up all the potential net unit importers in CP2, adding significance to the declaration. If implemented, this approach could prevent the use of most CP1 AAUs from countries whose CP1 targets were less stringent than BAU.

10 For additional details, see Morel (2013) and Kollmuss (2013).

5 OPTIONS TO ADDRESS THE RISK OF INTERNATIONAL TRANSFERS FROM COUNTRIES WITH NDC TARGETS LESS STRINGENT THAN BAU

International rules governing Article 6 are currently being negotiated under the UNFCCC. This includes rules, modalities and procedures for the Article 6.4 mechanism, as well as guidance for Article 6.2. Parties have different views on whether or to what extent the international guidance on Article 6.2 should address environmental integrity: some Parties argue that the guidance should be limited to robust accounting, whereas others argue that the guidance should extend to other requirements under Article 6.2, including environmental integrity.

Based on previous research (Schneider, Füssler, La Hoz Theuer, et al. 2017; Aldrich and Koerner 2012; Vieweg et al. 2012) and on Party submissions,[11] we identify several broad approaches to address the risk of international transfers from countries with NDC targets less stringent than BAU (Figure 5).

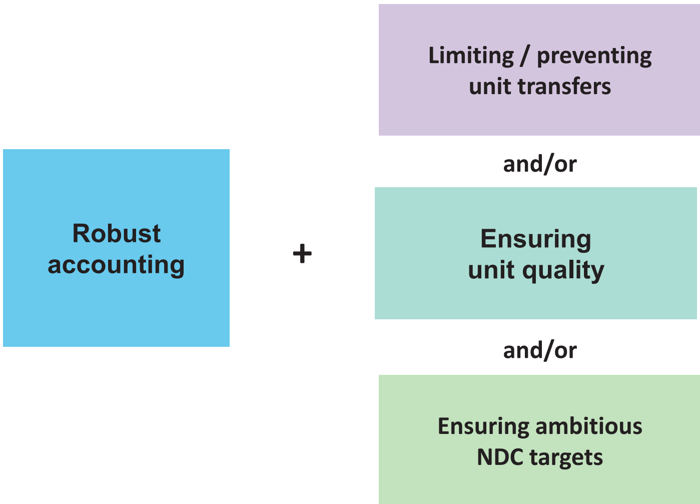

Figure 5: Broad approaches to ensure environmental integrity

First off, robust accounting is a key pre-requisite for ensuring environmental integrity, but not sufficient on its own. To ensure environmental integrity, robust accounting has to be complemented by at least one of three approaches:

1. **Limiting or preventing ITMO transfers**: International transfers could be subject to quantitative limits or eligibility requirements. Limits could aim to prevent or reduce the amount of hot air that can be transferred. Similarly, eligibility criteria could be put in place to ensure that countries with NDC targets less stringent than BAU are not allowed to engage in international transfers. This latter option, although theoretically possible, is unlikely to gain political acceptance and is not considered further in this study.

2. **Ensuring that ITMO transfers are backed by units that have quality**: If units have quality, then environmental integrity is safeguarded even if the transferring country has an NDC target less stringent than BAU. While Article 6.4 is commonly understood to be subject to international oversight – including on unit quality – it is less clear how unit quality will be addressed under Article 6.2. Environmental integrity under Article 6.2 could be facilitated, for example, through procedures for reporting and review, through guidance for the design of mechanisms and through eligibility criteria for the design of mechanisms. Options outside the purview of the UNFCCC – such as Green Investment Schemes, carbon clubs and discount rates – could also contribute to ensuring unit quality.

11 http://www4.unfccc.int/submissions/SitePages/sessions.aspx?showOnlyCurrentCalls=1&populateData=1&expectedsubmissionfrom=Parties&focalBodies=SBSTA

3. **Ensuring ambitious NDC targets**: If NDC targets are ambitious, then environmental integrity is ensured even if ITMO transfers are not backed by units that have quality. Theoretically, eligibility criteria could be established whereby only countries with ambitious NDC targets would be allowed to transfer ITMOs. In practice, however, assessing the ambition of NDC targets would be both technically and politically very challenging. This option is thus not further explored here.

This study focuses primarily on quantitative limits on international transfers (Section 6). Options to ensure unit quality are briefly discussed in Section 7.

6 LIMITS ON INTERNATIONAL TRANSFERS

International transfers under Article 6 of the Paris Agreement could be made subject to quantitative limits. Limits could be pursued to achieve different policy objectives. First, they are considered as one of the possible means to avoid the international transfer of hot air. Second, they could also help dissuade transferring countries from reducing the ambition of future NDC targets in order to sell more ITMOs. And third, limits could also be introduced with the view to addressing the risk of "over-selling". As achieving NDC targets is not legally binding under the Paris Agreement, there is a risk that some countries might – in the absence of any limits – transfer more ITMOs than they could in order to still achieve their targets.

Limits have been proposed in submissions by Parties, such as by the Like-Minded Developing Countries Group,[12] the Arab Group[13] and Brazil.[14] They are also mentioned in an informal note prepared by the co-facilitators of the UNFCCC negotiations on Article 6. Under the headline "limits and safeguards", the note lists several terms, including "supplementarity", "limits and controls on internationally transferred mitigation outcomes, trading, tradable units", and "system for addressing hot air", among others.[15]

This chapter explores different options to implement limits on international transfers. Section 6.1 discusses key design features of limits and Section 6.2 road-tests limits by assessing the impacts of different options for specific countries.

6.1 Key design features

Limits could be established in many different ways. This section discusses key design features. This includes:

- Two generic ways of establishing limits: relative and absolute limits (Section 6.1.1);
- The applicability of limits to countries (Section 6.1.2);
- The applicability of limits to specific types of transfers (Section 6.1.3);
- The point of application, including whether the limits are applied at the issuance, transfer or use of ITMOs (Section 6.1.4);
- Methods for determining the level of the limit (Section 6.1.5); and
- The timing of establishment, application, and assessment of limits (Section 6.1.6).

6.1.1 Relative and absolute limits

Limits on international transfers could be established in two distinct ways, which are here referred to as **relative** and **absolute** limits.

6.1.1.1 Relative limits

Under **relative limits**, countries can transfer ITMOs to the extent that they reduce their emissions below the limit. Figure 6 illustrates the concept for a country with a NDC target for 2030

12 http://www4.unfccc.int/Submissions/Lists/OSPSubmissionUpload/713_317_131364934648087255-LMDC%20Submission%20on%20the%20Article%206%20of%20the%20Paris%20Agreement%20-%20SBSTA%2046.pdf

13 http://www4.unfccc.int/Submissions/Lists/OSPSubmissionUpload/102_317_131375779687492508-Arab%20Group%20Submission%20on%20Articles%206.2%20%206.4%20(Revised%20Version)%20(002).pdf

14 (http://www4.unfccc.int/Submissions/Lists/OSPSubmissionUpload/525_317_131354419477778493-BRAZIL%20-%20Article%206.2.%20SBSTA46%20May%202017.%20FINAL.pdf), October 2016 (http://www4.unfccc.int/Submissions/Lists/OSPSubmissionUpload/525_262_131198656223045434-BRAZIL%20-%20Article%206.2%20final.pdf) and November 2014 (http://www4.unfccc.int/submissions/Lists/OSPSubmissionUpload/73_99_130602104651393682-BRAZIL ADP Elements.pdf)

15 http://unfccc.int/files/meetings/bonn_may_2017/in-session/application/pdf/sbsta_10a_informal_note_final.pdf

that corresponds to an emissions level of 130 $MtCO_2e$ (black square). The NDC target is less stringent than the projected BAU emissions (blue line) which correspond to 100 $MtCO_2e$ in 2030. The country has thus hot air of 30 $MtCO_2e$ in 2030 (red arrow). The country implements mitigation actions which bring its emissions (black dashed line) down to 80 $MtCO_2e$ in 2030. In this example, the relative limit (orange line) is set exactly at the level of the BAU emissions in 2030. The amount of ITMOs the country is allowed to transfer in 2030 corresponds to the reduction of emissions below the limit (green arrow), i.e. 20 $MtCO_2e$ (100 - 80 $MtCO_2e$).

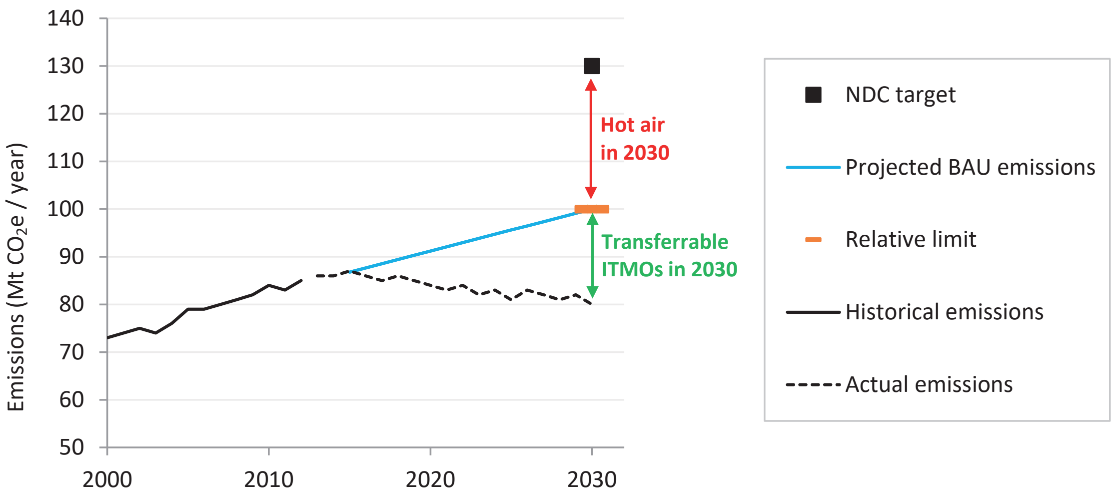

Figure 6: Relative limit based on BAU emissions projection in 2030

If the main objective of limits is preventing the transfer of hot air while enabling the transfer of emission reductions from mitigation actions, relative limits that appropriately reflect BAU emissions would – theoretically – be the ideal solution. Because the limit is set exactly at the BAU emissions level, the country can transfer ITMOs that result from the mitigation actions, while it cannot transfer its hot air. The limit would allow transfers to the extent that the country takes mitigation action and reduces its emissions below the BAU level, as shown in Figure 6. Moreover, such limits would only restrict ITMO transfers from countries that have a target that is *less* stringent than BAU, but not take effect if countries have a target that is *more* stringent than BAU.

This type of limit is referred to here as a *relative* limit because it would allow the country to transfer any amount of ITMOs – as long as it reduces emissions respectively. Thus, the main advantage of relative limits is that they could address the risk of the transfer of hot air, while at the same time not limit the ability of countries to engage in international ITMO transfers that result from mitigation actions.

If the main objective of limits is to provide incentives for countries to adopt more ambitious mitigation targets, relative limits could also be set at more ambitious emission levels, such as emission levels that are deemed consistent with the long-term goals of the Paris Agreement.

Implementing relative limits would require establishing the level of the limit and determining the actual GHG emissions of the country. The amount of ITMOs that a country is allowed to transfer is determined as the difference between the relative limit and the country's actual emissions in the target year or period:

MAXIMUM ITMO TRANSFERS = RELATIVE LIMIT – ACTUAL EMISSIONS

If the actual emissions in the target year or period are higher than the relative limit – such that the result from the equation is negative – countries would not be able to transfer ITMOs internationally.

Independent of the limit, the country would also have to ensure that it achieves its NDC target and does not "over-sell" ITMOs. If the NDC target is more stringent than the relative limit, this implies that the NDC target – and not the relative limit – is decisive for how many ITMOs that country can transfer: the country could transfer ITMOs to the extent that it reduces its emissions below the emissions level of the NDC target. In this case, the relative limit would not have any consequences for the country.

Establishing the level of the limit is a critical challenge. Based on our definitions of environmental integrity and hot air, relative limits would ideally be based on a BAU projection that reflects the most likely future emissions level with current policies in place at the time of setting the target. This is both technically and politically challenging. BAU emissions projections are uncertain due to assumptions, methods and data availability (see Section 3.2). A comparison of nationally-established BAU projections with independently-established BAU projections (Climate Action Tracker 2017) indicates that some of the BAU projections contained in NDCs could be inflated and based on unrealistic assumptions.

To mitigate these risks, BAU emissions projections could potentially be based on an internationally agreed methodology. Such a methodology could include provisions to ensure consistency and comparability between countries and to address the uncertainty of key variables such as economic growth. Yet preparing BAU emissions projections can be complex and agreeing on a common methodology could be politically difficult. Moreover, an international methodology may only partially be able to reduce uncertainty and a possible bias. This is because it is likely that such methodology would have to rely strongly on country-specific assumptions, and countries could have incentives to make assumptions that tend to over-estimate BAU emissions. This makes the implementation of limits based on BAU emissions projections both politically and technically difficult.

Given these challenges, alternative approaches for determining the level of relative limits could be explored. These involve, notably, using parameters other than projections of BAU emission to derive the limit, such as historical emissions. Some of these approaches and methods to determine such limits are further explored and road-tested below.

6.1.1.2 Absolute limits

Under **absolute** limits, countries can issue, transfer or acquire only a certain absolute (or fixed) number of ITMOs. The limit could apply to the transferring or acquiring country. The level of the limit could be determined based on different parameters, such as a percentage of historical GHG emissions before the target year or period, actual GHG emissions in the target year or period, or the emissions level corresponding to the NDC target. Box 1 provides an example of a limit established as a percentage of the NDC target level.

Unlike relative limits, absolute limits do not specifically aim to avoid transfers that pose environmental integrity risks. Rather, they generally limit the volume of international transfers, and thereby reduce the environmental risks from such transfers. In other words, whereas relative limits could theoretically fully address the environmental integrity risk from the transfer of hot air, absolute limits instead contain the risk by reducing the volume of such transfers.

6.1.2 Applicability to countries

Limits could apply either to transferring or acquiring countries or only to some groups of countries. In this section, we discuss different options for the applicability to countries.

A related but distinct issue are eligibility criteria to participate in international transfers. Here we understand "applicability" as the countries to which a certain international rule – such as limits on

Box 1: Example of an absolute limit based on the percentage of the target level

A country has a single-year target for 2030 that corresponds to an emissions level of 100 million tCO_2e in that year. A limit is established whereby countries can only transfer ITMOs corresponding to up 5% of their NDC target level. The country could thus be allowed to transfer a maximum of 100 x 5% = 5 million tCO_2e in 2030. The limit would thus be calculated with the following equation:

LIMIT = NDC TARGET EMISSIONS LEVEL × THRESHOLD VALUE

A similar type of limit was introduced under the Kyoto Protocol in the form of a commitment period reserve, which requires that each Party maintain a reserve of units covering at least 90% of the Party's assigned amount or five times its most recently reviewed GHG inventory emissions, whichever is lowest (see Section 4.1.3).

international transfers – applies. By contrast, "eligibility" pertains to a set of requirements with which countries must comply in order to be allowed to engage in international transfers.

6.1.2.1 Applicability to transferring or acquiring countries

Relative and absolute limits differ in how they could be applied to transferring and acquiring countries. **Relative** limits make sense only for transferring countries. **Absolute** limits, however, could be applicable to both transferring and/or acquiring countries. The commitment period reserve under the Kyoto Protocol, for example, is an absolute limit applied to the transferring country. Absolute limits for acquiring countries would require countries to achieve part of their mitigation effort domestically. Such limits could be pursued to implement the principle of "supplementarity" (see Section 4.1.3).

Whether absolute limits should be placed on transferring or acquiring countries depends on the objective pursued. If the main objective is ensuring that countries achieve some mitigation domestically, limits should be placed on acquiring countries. If the main objective is containing the risk of hot air transfers, absolute limits on transferring countries may be more appropriate. Limits placed only on acquiring countries may do little to contain the risk of hot air transfers, because transferring countries could still in principle transfer all of the hot air contained in their NDC. Acquiring countries could, moreover, prioritize acquisition of hot air as this would be the lowest cost option in economic terms: since ITMOs generated from hot air do not involve any mitigation action, there is also no cost in generating them. Thus, unless absolute limits placed on acquiring countries are highly restrictive, they may have little or no effect in preventing the transfer of hot air. Absolute limits placed on transferring countries, on the other hand, could prevent some of the hot air from being transferred – if limits are set below the potential quantity of hot air from these countries. For this reason, we focus our further analysis on limits applied to transferring countries.

6.1.2.2 Applicability to groups of countries

Limits could apply to all countries, or only to some countries. Differentiation between countries could be pursued, for example, to reflect the capabilities and responsibilities of countries. Restricted country applicability could be implemented based on Party groupings under the UNFCCC or the Paris Agreement, such as least developed countries (LDCs) or small island developing states (SIDS).

However, our evaluation of NDC targets indicates that hot air could be present in NDCs from many different countries, including LDCs. The environmental risk is thus not lower for specific groups of countries. Moreover, a differentiation by countries could prove to be politically difficult. If differentiation is pursued, it may be politically more acceptable if it is based on well-established country groups or based on other objective criteria.

6.1.3 Applicability to types of transfers

Transfers could encompass several types of mechanisms and transfers. This implies that different types of transfers could involve different environmental integrity risks. The applicability of limits could thus be differentiated both in terms of the relevant Article and/or in terms of the (type of) mechanism through which ITMOs are transferred.

6.1.3.1 Applicability to Article 6.2 and Article 6.4

International transfers under the Paris Agreement could take place either under the provisions of Article 6.2 and/or under the provisions of Article 6.4. Articles 6.2 and 6.4 have different purposes in the Paris Agreement. Cooperative approaches under Article 6.2 allow countries to use ITMOs to achieve their NDCs, whereas Article 6.4 establishes a new crediting mechanism. The wording of Article 6.2 suggests that Parties are the main responsible entities for ensuring the principles set out in the Article. Most Parties do not envisage a strong international oversight on how Parties ensure the quality of international transfers.

By contrast, the mechanism under Article 6.4 is established under the authority and guidance of the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement (CMA), and is supervised by a body designated by the CMA. It is thus understood to be a centralized UNFCCC mechanism with international oversight, similar to the CDM and Track 2 of JI under the Kyoto Protocol, although it is possible that Parties will devolve more authority to host governments than was the case under the Kyoto Protocol.

Limits on international transfers could apply either to both Articles or only to one of them. Mechanisms under international oversight are often seen to provide for a higher degree of unit quality than mechanisms under oversight by Parties. Parties could thus consider applying limits only to ITMOs generated under the authority of Parties under Article 6.2 but not to emission reductions issued under Article 6.4.

Whether such an approach addresses environmental integrity concerns depends strongly on the extent to which international oversight ensures the quality of units. The experience from the Kyoto Protocol suggests that international oversight can facilitate – but does not guarantee – the quality of units. For example, the quality of ERUs issued under JI was found to be higher under Track 2, which is subject to international oversight, than under Track 1, which was implemented under the authority of Parties. On the other hand, several studies point to environmental integrity shortcomings of mechanisms for which international oversight is provided (see Section 4.1.1).

6.1.3.2 Applicability to types of ITMO transfers

The Paris Agreement does not further specify how ITMOs are transferred between countries. In principle, it seems possible that ITMOs are transferred in two ways:

- **ITMO transfers backed by mechanisms**: Two countries could use mechanisms to engage in cooperative approaches. This could include crediting mechanisms, international linking of ETSs, and possibly other mechanisms, such as green investment schemes. The countries could agree to account for the net transfer of units from the underlying mechanisms as ITMOs towards achieving their NDC targets.
- **ITMO transfers not backed by mechanisms**: Two countries could agree to account for ITMOs towards their NDC without involving mechanisms such as a crediting mechanism or an ETS.

The risks to environmental integrity could be higher for ITMO transfers that are not backed by unit flows from mechanisms, as any hot air could be directly transferred. If ITMO transfers are backed by mechanisms, the risks may also differ between different types of mechanisms. Countries could therefore consider applying limits only to those types of ITMO transfers that may pose higher risks to environmental integrity.

One option could be not to apply limits on ITMO transfers that are backed by an international linkage between ETSs. Several countries have established or are planning linkages between ETSs. In this context, an important question is whether the net flow of allowances between the ETSs are accounted for as ITMOs towards NDC targets. Accounting for the net flows of allowances as ITMOs would address the risk that a country which is a net acquirer of ETS allowances may not achieve its NDC target if it cannot account for the unit inflow. Accounting for the net flow as ITMOs may thus be important if the net flow is material as compared to the overall emissions of the acquiring country.

In practice, accounting for the net flow of allowances may face constraints. Entities in ETSs can usually hold and bank allowances, which exacerbates determining the "net flow". It is therefore also conceivable that countries do not account for the allowance flows from international linking towards achieving their NDC targets. This may be a pragmatic approach if the amount of net transfers is relatively small in comparison to the overall emissions of the countries involved, or if both countries are confident that they will achieve their NDC targets, regardless of the transfer of allowances between their ETS. Currently, the linkage between the ETSs in California and Quebec is not accounted for internationally. However, the EU and Switzerland agreed that they will account for the net flow of allowances "in accordance with the future rules on accounting that are currently being developed under the UNFCCC".[16]

Several considerations are important when considering exempting ITMO transfers backed by linkages of ETSs from limits:

- **Environmental integrity risks**: Linkages of ETSs may involve more limited environmental integrity risks than other types of transfers. The environmental integrity risks from international linking of ETS mostly depend on the level of the caps. For ETSs, a significant challenge is over-allocation of allowances, which has been a pervasive problem in ETSs established to date (IETA 2015). As noted in Section 2.2, if an ETS with an ambitious cap is linked to one that is over-allocated, that linking could reduce the aggregated abatement from both systems. International linkages of ETSs are, however, expected to occur mainly among countries with similar levels of ambition. That is, countries with more ambitious NDC targets (and corresponding ETS caps) are unlikely to link to ETSs in countries with significantly less ambitious targets (Ranson and Stavins 2016). The environmental integrity risks from linking of ETSs may thus be limited.

- **Ability of countries to adhere to limits**: When linking ETSs, the net flow of allowances depends on many circumstances – such as fuel prices, economic growth or weather conditions – which may change over time. Once an ETS is established, the unit flow is driven by the decisions of the regulated entities. The amount and the direction of the net flow between the ETSs could change over time, and governments have no or only limited control on the amount of allowances transferred. If countries intend to account for the net flow as ITMOs, then international limits on ETSs could pose the risk that a country may not be able to comply with the limit. By contrast, for other types of international transfers, such as government purchases of credits, transferring and acquiring countries can manage the amount of units they transfer or acquire. Exempting ITMO transfers backed by linkages of ETSs from international limits would address this concern. Alternatively, countries could include restricted forms of linking, in order to align the linking of ETS with any international limits (Schneider, Lazarus, Lee, et al. 2017). For example, countries could establish a quota for the amount of allowances that can be

16 https://ec.europa.eu/clima/sites/clima/files/ets/markets/docs/com_2017_427_en.pdf

transferred between two ETS that corresponds to the limit at international level. Whether such a quota would effectively limit the transfer of allowances depends next to the level of the quota and the GHG abatement potential and costs in the linked ETSs. While quotas could in some instances restrict allowance transfers, they might enable to reap a large share of the potential economic benefits from linking ETSs (Schneider, Lazarus, Lee, et al. 2017). Establishing quotas may, however, be politically difficult, in particular if links have already been established.

- **Differentiating between types of ITMO transfers**: Distinguishing ITMO transfers backed by linkages of ETSs from other types of transfers could be complex. First, it would require international agreement on a definition of ETSs and subsequent assessment what is considered an international linkage of ETSs. And second, it may require an international assessment what the net flow of allowances between the ETSs is, in order to determine which quantity of ITMO transfers are exempt from limits. Both could be technically and politically challenging. There might also be a risk that countries establish schemes that qualify as an ETS but that do not provide for unit quality – solely for the purpose of being exempt from any international limits. Differentiating between types of ITMO transfers could also raise concerns about the perception of different qualities of ITMOs.

A second option could be applying limits only to ITMO transfers that are not backed by mechanisms. This option would entail similar challenges as exempting ITMO transfers backed by linkages of ETSs. It could, for example, be difficult to clearly define what a "mechanism" is, as countries have implemented several types of mechanisms that involve transfers of permits, rights, or allowances, such as green investment schemes or renewable energy certificates. Moreover, not all mechanisms may ensure quality. Crediting mechanisms, for example, can face considerable challenges in ensuring unit quality, e.g. due to the information asymmetry between project developers and regulators and due to the uncertainty of assumptions on future developments when assessing additionality and establishing baselines.

A third approach could be exempting ITMO transfers that comply with certain international criteria for environmental integrity or governance arrangements. For example, mechanisms could undergo an international review – such as the assessment of programs for eligibility under CORSIA – based on internationally agreed criteria. If mechanisms are found to comply with the criteria, ITMO transfers backed by these mechanisms would not be subject to international limits.

6.1.4 Point of application

Internationally agreed limits are only effective if they are adhered to when countries account for their NDCs. This raises the question of when limits should be applied under the Paris Agreement. This depends on how robust accounting will be implemented and how the nature and scope of ITMOs will be defined under the Paris Agreement. Several scenarios are possible, of which two are briefly discussed here:

1. **Accounting through corresponding adjustments, without establishing ITMOs as international units**: Parties could agree to establish a framework for applying "corresponding adjustments", as referred to in paragraph 36 of decision 1/CP.21, without establishing international units, registries or centralized tracking systems, such as international transaction logs. In this case, the limit could be applied ex post when countries apply corresponding adjustments and account for their NDCs, e.g. as part of an accounting balance. The level of all corresponding adjustments applied by a country would have to be within the limit. It would be the responsibility of countries to ensure that they authorize only transfers within the limit. International oversight may be needed to ensure that all corresponding adjustments by Parties match up.

2. **Establishment of ITMOs as an international unit, with international tracking of transfers**: Parties could agree to establish ITMOs as an international unit that is transferred within a centralized registry or between registries operated by Parties. Transfers of ITMOs could be reported or tracked internationally. This option would allow limits to be applied on an ongoing basis. If ITMOs were established as international units, limits could be applied at different points:

    - **Limits placed on acquiring countries**: Limits placed on acquiring countries could be applied either at the acquisition of ITMOs or when ITMOs are used to achieve the country's NDC target. It may be simpler to apply the limit when ITMOs are used to achieve NDC targets. This would allow acquiring countries to both acquire and transfer ITMOs without any restrictions, as long as the amount of ITMOs they use for compliance does not exceed their limit. This may facilitate the implementation of carbon markets as it could enable private entities, such as banks or brokers, to acquire, hold or transfer ITMOs without limitations.

    - **Limits placed on transferring countries**: Limits placed on the transferring country could be applied when ITMOs are issued or when they are transferred. Limits on the issuance could provide for administrative simplicity and ex ante certainty in the application of the limit, in particular if issuance of ITMOs is internationally tracked, such as through transaction logs. Limits on transfers could be more complex to implement, as the limit would have to be applied to the net balance of issued, transferred and acquired ITMOs.

If limits are placed on transfers or acquisitions, it seems reasonable that any international limits would only apply on the basis of "net" transfers. That is, countries could both acquire and transfer ITMOs, as long as the balance between transfers and acquisitions does not exceed the limit.

6.1.5 Methods for determining the level of limits

One of the main design features of limits is how the level of the limit is determined. In considering methods for determining the level of limits, policy-makers may have to balance various policy objectives. Those include addressing the environmental risk, in particular from international transfers of hot air; facilitating participation in international transfers, in particular for countries that effectively engage in mitigation action; and providing incentives for increasing the ambition of future NDC targets. Limits should, moreover, also be set to minimize the possibility of manipulation that could result in higher limits, and should be determined in methodologically simple ways. The methodology should therefore have international agreement and should be applied consistently across countries. Given the diversity among national contexts, methods to establish limits may also have to address countries' various development circumstances and GHG emission pathways. Trade-offs between these policy objectives will likely be necessary. The setting of limits is ultimately a policy choice that balances these policy objectives.

Below we introduce possible methods for establishing relative and absolute limits, as well as a concrete proposal for limits by Brazil. This includes the parameters, methods and reference periods that could be used to calculate the level of the limit. These issues are also further discussed and road-tested in Section 6.2 below.

6.1.5.1 Relative limits

Relative limits could be established in a number of ways. If the main objective is preventing the transfer of hot air while enabling countries to transfer ITMOs that result from mitigation action, relative limits would ideally be set at the level of BAU emissions. Given the difficulties with establishing BAU emissions, we explore here alternative approaches for setting relative limits.

A first important aspect is from which **parameter** the limit should be derived. Several Parties have proposed that historical GHG emissions be used. Alternatively, historical emissions could also be related to other parameters, such as the gross domestic product (GDP) or population. Other parameters are also conceivable, such as the carbon intensity of the energy system (i.e. GHG emissions per fuel consumption).

Second, once a parameter is chosen, different **methods** could be applied to calculate the relative limit. Where historical data is used, different calculations can be employed – such as a simple average (e.g. the average historical GHG emissions over three years), or the extrapolation of a recent trend (e.g. assuming a continued trend of the historical emissions intensity, i.e. GHG emissions per GDP).

Third, different **reference periods** could be used to calculate the limit. Reference periods may have different lengths (e.g. 3, 5 or 10 years) and different starting points (e.g. historical GHG emissions in the period immediately preceding the contribution period, or historical emissions in the period preceding the communication of the NDC). Shorter reference periods could be more appropriate in reflecting recent developments, while longer reference periods may be more representative of the longer-term emissions path. The choice of the period also impacts when the limit can be calculated (see Section 6.1.6).

Box 2 provides two examples of how relative limits could be determined. The examples illustrate limits for two situations: a multi-year target for the period of 2021 to 2030 and a single-year target for 2030.

Box 2: Examples of relative limits

Example 1: Relative limit for a multi-year target based on an extrapolation of GHG emissions trends

A country has a *multi-year* NDC target for the period 2021 to 2030. The target corresponds to an average emissions level of 120 million tCO_2e per year for this period. A relative limit is established by extrapolating the emissions trend in the five-year period from 2016 to 2020 to the period from 2021 to 2030, e.g. by conducting a linear regression analysis. The extrapolated emissions trend corresponds to an average GHG emissions level of 100 million tCO_2e per year for the period 2021 to 2030. The country reduces its emissions to an average level of 90 million tCO_2e over the period 2021 to 2030. The country can thus transfer 100 million tCO_2e over the period (100 – 90 = 10 million tCO_2e, multiplied by 10 years). The maximum volume of ITMO transfers would be calculated with the following equations:

MAXIMUM ITMO TRANSFERS = (RELATIVE LIMIT × LENGTH OF THE PERIOD) – ACTUAL EMISSIONS IN THE NDC PERIOD

where

RELATIVE LIMIT = GHG EMISSIONS TREND EXTRAPOLATED FROM THE PRE-TARGET PERIOD

Example 2: Relative limit for a single-year target based on average historical GHG emissions per GDP (emissions intensity)

A country has a *single-year* NDC target that corresponds to an emissions level of 120 million tCO_2e in 2030. A relative limit is established based on the average historical emissions per GDP in the period 2018–2020. In this period, the average GHG emissions per GDP for the country are 0.5 kg CO_2e / USD. In 2030, the country's GDP is 200 billion USD. Multiplying the 2018–2020 GHG emissions per GDP value by the 2030 GDP gives a relative limit of 100 million tCO_2e. The country reduces its emissions to an average level of 90 million tCO_2e in 2030. The country can thus transfer 10 million tCO_2e in 2030 (100 – 90 = 10 million tCO_2e). The maximum volume of ITMO transfers would be calculated with the following equations:

MAXIMUM ITMO TRANSFERS = RELATIVE LIMIT – ACTUAL EMISSIONS IN THE NDC TARGET YEAR

where

*RELATIVE LIMIT = AVERAGE HISTORICAL GHG EMISSIONS PER GDP * GDP IN THE TARGET YEAR*

6.1.5.2 Absolute limits

Similar to relative limits, absolute limits could be derived from different **parameters**. Possible parameters include, for example:

- Historical GHG emissions;
- Historical emissions per GDP;
- A GHG emissions level corresponding to the NDC target; or
- Actual GHG emissions in the contribution period.

The simplest **method** to calculate an absolute limit is a fixed percentage point of the parameter (e.g. 5% of historical GHG emissions, see Box 3). Similar to relative limits, absolute limits could be calculated using different **reference periods**, including historical periods, or the period over which an NDC target is defined. Also, in this case the starting point and the length of the reference period are key choices.

Box 3: Examples of absolute limits

Example 1: Absolute limit for a transferring country with a multi-year NDC target calculated as a percentage of historical emissions

A country has a *multi-year* NDC target for the period 2021 to 2030, corresponding to an average emissions level of 100 million tCO_2e per year in the period. The country's average emissions in the years preceding the communication of the NDC target (e.g. 2013-2015) are 110 million tCO_2e per year. An absolute limit is established whereby international transfers are limited to 5% of each country's average annual historical emissions, multiplied by the length of the contribution period. This would mean that the country could transfer 55 million tCO_2e in the period 2021–2030 (calculated as 110 million tCO_2e per year in 2013-2015, multiplied by 5%, multiplied by 10 years). The limit would thus be calculated with the following equation:

MAXIMUM ITMO TRANSFERS = AVERAGE HISTORICAL EMISSIONS × THRESHOLD VALUE × LENGTH OF THE PERIOD

Example 2: Absolute limit for a transferring country with a single-year NDC target calculated as a percentage of the target level

A country has a *single-year* NDC target for 2030 that corresponds to an emissions level of 100 million tCO_2e. An absolute limit is established whereby countries can only transfer ITMOs corresponding to up 5% of their NDC target level. The country could thus transfer a maximum of 5 million tCO_2e in 2030 (calculated as 100 million tCO_2e multiplied by 5%). The limit would thus be calculated with the following equation:

MAXIMUM ITMO TRANSFERS = NDC TARGET EMISSIONS LEVEL × THRESHOLD VALUE

Example 3: Absolute limit for an acquiring country with a multi-year NDC target based on the NDC target level and emissions in pre-target years

A country has a *multi-year* NDC target for the period 2021 to 2030, corresponding to an emissions level of 100 million tCO_2e per year in the period. An absolute limit is established whereby the country can only use ITMOs to fulfill 50% of the difference between its GHG emissions in the period preceding the NDC and its target level. The country's average emissions in the five years preceding the contribution period (i.e. from 2016 to 2020) lie at 110 million tCO_2e per year. The country can thus only use up to 50 million ITMOs in the period 2021–2030 (calculated as 110 minus 100 million tCO_2e per year, multiplied by 50%, multiplied by 10 years). The limit would thus be calculated with the following equation:

MAXIMUM ITMO TRANSFERS = (AVERAGE EMISSIONS IN THE PRE-TARGET PERIOD – AVERAGE NDC TARGET EMISSIONS LEVEL) × THRESHOLD VALUE × LENGTH OF THE PERIOD

Box 3 provides three examples of how absolute limits could be determined, including for multi-year and single-year targets, as well as for transferring and acquiring counties.

6.1.5.3 Brazilian proposals

Since 2014, Brazil has put forward three proposals for limits on international transfers, as described in Box 4.

The proposals from 2016 and 2017 are meant to apply to Article 6.2 but not to the Article 6.4 mechanism. The three proposals partially differ but also have common elements. One key common element is the conversion of single-year targets into multi-year budgets or trajectories for the purpose of ITMO transfers. They also seem to share another common element – embodied most clearly in the October 2016 version – that could be interpreted as a relative limit based on average historical GHG emissions, although the reference period for historical emissions is not clear. This latter interpretation hinges on the understanding that Brazil expects countries to achieve their NDCs; absent this assumption, the 2014 Brazilian proposal could be read as an absolute limit in which countries can transfer an amount of ITMOs equal to the yearly average historical GHG emissions, and can "over-sell" ITMOs. Another interpretation refers specifically to the March 2017 proposal. Here, we interpret that the proposal actually meant to refer to what cannot be traded, instead of describing what can be traded; in other words, we interpret the proposal to mean that the difference between the NDC target and the average annual emissions, multiplied by the number of years in the NDC timeframe, is what the Party would be able to transfer internationally – with the remainder not eligible for international transfers.

We thus interpret here the Brazilian proposals as a relative limit that is established for a multi-year period and that is based on the average historical GHG emissions of the country as reported in recent GHG inventories, hereinafter referred to as the "consolidated Brazilian proposal". The implications are different for countries with decreasing and increasing emissions trends, as illustrated through the following examples:

- **Countries with decreasing emissions trends**: A country has a multi-year NDC target for the period 2021 to 2030, corresponding to an average emissions level of 110 million tCO_2e per year in the period. The country's average emissions in recent years before the target period are 100 million tCO_2e per year. The country reduces its emissions to an average level of 90 million tCO_2e over the NDC period. The average historical emission level of 100 million tCO_2e per year is used as a relative limit. The country can thus transfer 100 million tCO_2e over the period (100 – 90 = 10 million tCO_2e, multiplied by 10 years). This, however, is less than the difference between the NDC target and actual emissions during the period, which equals 200 million tCO_2e over the period (110 – 90 = 20, multiplied by 10 years). The limit thus effectively reduces the number of ITMOs the country can transfer. The remaining 100 million tCO_2e would have to be kept in a reserve.
- **Countries with increasing emissions trends**: As in the previous example, a country has a multi-year NDC target for the period 2021 to 2030, corresponding to an average emissions level of 110 million tCO_2e per year in the period. Different from the previous example, the country's average emissions in the years preceding the communication of the NDC target (e.g. 2013-2015) are 90 million tCO_2e per year, whereas the country's actual emissions amount to an average level of 100 million tCO_2e over the NDC period. The average historical emissions level of 90 million tCO_2e per year is used as a relative limit. The country cannot transfer ITMOs over the NDC period, since its actual emissions during the period (100 million tCO_2e, multiplied by 10 years) lie above the relative limit for the period (90 million tCO_2e, multiplied by 10 years).

The maximum volume of ITMO transfers under this interpretation of the Brazilian proposal would be calculated with the following equations:

Box 4: Brazilian proposals

Brazilian November 2014 proposal

In its submission dated 6 November 2014,[a] Brazil made a proposal of an "Economic Mechanism" that would include an "Emission Trading System" which could be used by certain countries and that would be subject to limits on the transferring country:

Countries that put forward in their NDC quantified, economy-wide absolute emission limitation or reduction targets may benefit from the emission trading system for the purpose of achieving their targets, subject to specific conditions to be determined by the agreement and subsequent decisions, to be adopted by the COP before 2020.

Based on lessons learned from the Kyoto Protocol, one of such conditions would be to limit the issuance of tradable allowances in a contribution term to five times the average level of emissions from the 3 previous latest available inventories or the NDC, whichever is lower. Domestic allowances, non-tradable, would be issued to a national reserve if the NDC is higher than the average level of emissions from the 3 previous latest available inventories. Trade would imply transfer of tradable allowances from the seller country to the buyer country.

Brazilian October 2016 proposal

In its October 2016 submission,[b] Brazil proposed that *"the amount of units eligible for trading should be limited to the difference between current emissions and the average of the last three inventories"*. Brazil also proposes that *"Parties wishing to engage under Article 6.2 to demonstrate achievement of their respective NDCs should be required to establish and quantify a budget of emission allowances or an annual trajectory of emissions towards their NDC objectives"*.

Brazilian March 2017 proposal

In its March 2017 submission,[c] Brazil proposes the following approach to limiting international transfers under Article 6.2:

Brazil understands that, for the purpose of trading mitigation outcomes towards NDCs, Parties wishing to voluntarily engage in the 6.2 mechanism should quantify their mitigation commitments communicated under the Paris Agreement, in terms of tCO2e that they will be limited to emit, annually, from 2020 in accordance with their communicated NDC. This process should entail the following steps:

- firstly, Parties should calculate how many tCO_2e they would be allowed to emit in the end year of their NDC, when achieving their own NDC mitigation commitment;

- secondly, the end year tCO_2e allowance should be multiplied by the number of years in a given NDC time frame;

- thirdly, the resulting figure should be converted into an equivalent pool of units, each corresponding to one tCO2e;

- fourthly, if its NDC end year tCO_2e allowance is superior to the average annual emissions for the years preceding the NDC timeframe, as shown in its last inventories, such a difference multiplied by the number of years in the given NDC time frame for the Party would be reserved for domestic use only (retirement) – i.e., demonstrate achievement of the NDC. In other words, such difference would not be eligible for international transfers.

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a http://www4.unfccc.int/submissions/Lists/OSPSubmissionUpload/73_99_130602104651393682-BRAZIL ADP Elements.pdf

b http://www4.unfccc.int/Submissions/Lists/OSPSubmissionUpload/525_262_131198656223045434-BRAZIL - Article 6.2 final.pdf

c http://www4.unfccc.int/Submissions/Lists/OSPSubmissionUpload/525_317_131354419477778493-BRAZIL - Article 6.2. SBSTA46 May 2017. FINAL.pdf

MAXIMUM ITMO TRANSFERS = (RELATIVE LIMIT × LENGTH OF THE PERIOD) – ACTUAL EMISSIONS IN THE NDC PERIOD

where

RELATIVE LIMIT = AVERAGE HISTORICAL GHG EMISSIONS

This interpretation of the Brazilian proposal is one of the options for relative limits road-tested in Section 6.2 below.

6.1.6 When to establish, apply and assess limits

In order to implement limits, several questions need to be addressed related to the timing of their application:

- When should limits be established?
- To which years or periods should limits be applied?
- How often should the calculation of the limit be updated?
- Should limits be adhered to on an ongoing basis or ex-post?

The answers may differ depending on whether absolute or relative limits are used, and on whether historical or contemporaneous reference periods are used to set those limits.

6.1.6.1 When should limits be established?

The answer to this question depends to some extent on the *reference period* that is used for establishing the limit. For both absolute and relative limits, if a historical reference period is used that ends well before the target year or contribution period, it is possible to establish the limit prior to any transfers taking place. This would provide ex ante certainty for countries on how many ITMOs they are allowed to transfer (for absolute limits), or how much they would have to reduce emissions in order to be allowed to transfer ITMOs (for relative limits). Ex ante certainty is important for a smooth functioning of carbon markets, especially where limits impact private sector activities, such as in linked ETSs and crediting schemes. It is also important for countries in order to ensure that they can achieve their NDC targets. Limits should thus preferably be established using a reference period before the target year or period. We explore limits established in this manner in Section 6.2.

Limits could also be established using a reference period that is contemporaneous with a target year or contribution period. In this case, for example, an absolute limit could be defined as a percentage of current-year emissions, and a relative limit could be set using a dynamically adjusted extrapolation of historical emissions (e.g., linked to changes in actual GDP levels). This approach would imply that the level of the limit could only be established ex post (after the target year or the contribution period, and hence possibly after transfers occur). This approach could be challenging to apply because it would afford little ex ante certainty about permissible transfers, creating uncertainty and compliance challenges (for example, a country might subsequently discover it has transferred beyond its limits and must therefore compensate for that).

An important consideration is that for some types of *absolute* limits, the precise amount of transferrable ITMOs can be known in advance. In the case of *relative* limits, the precise volume is known only once the actual emissions during the period are known. However, transferrable volumes could be calculated provisionally and ex ante on the basis of emissions projections.

6.1.6.2 To which years or periods should limits be applied?

In their first NDCs, most countries communicated single-year targets for 2025 or 2030, whereas a few countries have communicated multi-year targets (such as Armenia) or indicated that they would convert their single-year targets to multi-year emission trajectories (such as Switzerland). Single-year targets raise a number of accounting challenges. Common multi-year targets or trajectories would significantly facilitate accounting for international transfers. Article 4.10 of the Paris Agreement envisages "common time frames for NDCs" but these have not yet been agreed upon, and it is unclear whether these will entail single target years or multi-year periods.

Generally, it makes sense to apply any limits to the years or periods for which NDC targets and international transfers are accounted for. If international transfers are only accounted for in single target years, limits should apply also only in these years. If multi-year periods are used to account for international transfers, there are two options. An overall limit could be applied to the entire period, such that the aggregated sum of all transfers within the period has to be below one limit. Alternatively, a limit could apply to discrete subperiods within the target period (e.g., one year), such that the net amount of transfers in each subperiod has to be below a limit. The first approach could provide more flexibility to countries, as GHG emissions fluctuate due to economic or environmental conditions and so may the number of ITMOs that a country is able to transfer or needs to acquire to achieve its NDC target.

6.1.6.3 How often should the calculation of the limit be updated?

Limits could be calculated once and then applied to the target year or period, or they could be updated regularly. Where limits are established ex ante (using a historical reference period), it would generally make sense not to update the limit. However, the choice may also depend on the parameter(s) used to establish the limit. For example, an absolute limit based on a country's NDC target may need to be updated if the NDC is also updated. A limit established using a contemporaneous reference period may need to be updated regularly; as noted above, this could create uncertainty and compliance challenges.

6.1.6.4 Should limits be adhered to on an ongoing basis or after the target period or year?

Adherence to limits could be required (a) on an ongoing basis during the target year or period, or (b) ex post after the target year or period.

The first option means that the net balance of transfers (the difference between transfers and acquisitions) would have to be below the limit at any point in time (or within defined subperiods). This option would require systems, such as transaction logs, that are able to monitor adherence on an ongoing basis. It may therefore only be feasible at the international level if a system of international units is established. This option may provide greater assurance that countries do not exceed their limits, as transfers that infringe a limit could be prevented or detected early on.

The second option means that countries could engage in any amount of transfers throughout the target year or period, as long as the aggregated net volumes in the target year or period do not exceed the limit. This option provides more flexibility to countries, as they could temporarily exceed the limit and take action ex post to ensure that they comply with the limit for the target year or period. It is also easier to implement and compatible with a situation where ITMOs are accounted for through corresponding adjustments. Its effectiveness would crucially depend on the implementation of any necessary ex post corrections.

6.2 Road-testing options for determining limits

6.2.1 Purpose

In this section, we road-test different options for determining the level of limits. Both relative and absolute limits are tested, albeit in different ways. The analysis aims to assess the suitability and implications of different methods for determining the limit. The analysis focuses on two aspects: whether and how the approaches address the environmental integrity risk of international transfer of hot air, and whether and how they allow countries to transfer ITMOs that result from mitigation action.

Towards this end, we applied different options for determining the level of limits for 17 countries with different circumstances, including countries with targets that are more stringent than BAU and less stringent than BAU, and countries with increasing, stable or decreasing emissions trends. We selected countries for road-testing that represent a variety of geographic regions, economic development, country size, experience with market-based mechanisms, and data availability. The following countries were selected: Argentina, Brazil, China, Ethiopia, the European Union,[17] Gambia, India, Indonesia, Japan, New Zealand, Norway, Peru, Russia, South Africa, South Korea, Ukraine, United States.

We use information on BAU projections and NDC targets from Climate Action Tracker to understand how various options for determining limits might work in various contexts. As noted above, it is important not to interpret or confuse this road-testing of limits with a more holistic assessment of country-level NDC ambition.

6.2.2 Methodology and data sources

We tested relative and absolute limits separately.

Relative limits allow countries to transfer ITMOs to the extent that they reduce emissions below the limit. If the main objective of limits is preventing the transfer of hot air while enabling the transfers of emission reductions from mitigation actions, relative limits that appropriately reflect BAU emissions would – theoretically – best achieve both objectives (see Section 6.1.1.1). The closer a certain limit option lies to the BAU emissions projection for that country, the better the option performs in the context of that country. We therefore tested different options for limits by assessing the extent to which each option provides an approximation of the countries' projected BAU emissions.

The selection of options that were road-tested cover different parameters, methods of calculation and reference periods, in order to quantify and compare different approaches for establishing of limits. Table 5 summarizes the indicators, methods and reference periods road-tested for relative limits. Combining these features, we tested eight different options for establishing relative limits.

If an option results in a relative limit that is *higher* than projected BAU emissions and the NDC target, it would not impact the country's ability to engage in international transfers. But it could enable the country to transfer hot air if its NDC target is less stringent than BAU.

If an option results in a relative limit that is *lower* than projected BAU emissions and the NDC target, it would prevent the transfer of hot air but also limit the ability of the country to transfer ITMOs that result from mitigation actions.

For each of the options tested, we discuss the extent to which the transfer of hot air is prevented and the extent to which the transfer of ITMOs that result from mitigation action is possible.

17 For the purpose of this analysis, the European Union – comprised of 28 member states – is treated as a single country.

An important limitation of this approach is that BAU emissions projections are uncertain and NDC targets are often not fully clear (see Section 3.2). For these reasons, the results for a specific country are uncertain. However, road-testing the approaches in the context of different countries still provides important insights into whether and how the approaches could achieve the policy objectives pursued.

Table 5: Relative limits tested

Indicator	Method of calculation	Reference period
• GHG emissions	• Average historical level	• Three years preceding the communication of the NDC target with a time gap to account for data availability (2010 to 2012) (average)
• GHG emissions per GDP	• Historical trend extrapolated to the target period	• Five years preceding the communication of the NDC target with a time gap to account for data availability (2008 to 2012) (average + trend) • 10 years preceding the communication of the NDC target with a time gap to account for data availability (2003 to 2012) (trend)

Absolute limits allow countries to issue, transfer or acquire ITMOs up to a fixed amount. For each country and for each option for determining absolute limits, we calculated the level of the limit and assessed whether and how much of the country's hot air would be prevented from being transferred. This shows how the limit would restrict the transfer of hot air. We also discuss how the limits impact the ability of countries whose targets are more stringent than BAU to engage in international transfers.

Moreover, we estimated how many ITMOs could be transferred globally under each option for determining absolute limits. This depends on which countries would be the net acquirers or transfers of ITMOs. As this is uncertain, we provide a simple and approximate estimate of the overall ITMO volume that would be allowed to be transferred, by assuming that countries representing half of global GHG emissions would be transferring countries and that they would transfer ITMOs up to their limit.

The selection of absolute limits that were road-tested covers different possible approaches (see Table 6). We tested limits based on GHG emissions and the NDC target level. For illustrative purposes, we assessed the implications for fixed percentages of 1% and 5%, noting that any other values could be used.

Table 6: Absolute limits tested

Indicator	Method of calculation	Reference period
• GHG emissions	• Percentage (1% and 5%) of the average emissions level in the reference period	• Three years preceding the establishment of the NDC target with a time gap to account for data availability (2010 to 2012) • Three years preceding the target year with a time gap to account for data availability (e.g. 2025 to 2027 for a 2030 target)
• NDC target level	• Percentage (1% and 5%) of the target level	• NDC target year

The analysis of all options, for both relative and absolute limits, focuses on the year 2030. As highlighted in Section 6.1.6, most countries have put forward single-year targets, thereby creating a number of challenges for accounting for ITMOs and implementing international carbon markets (Howard, Chagas, Hoogzaad, et al. 2017; Prag et al. 2013; Lazarus et al. 2014; Schneider, Füssler, Kohli, et al. 2017). Rules for accounting for international transfers under the Paris Agreement are yet to be agreed upon, which may or may not include the establishment of multi-year target trajectories (Howard, Chagas, Hoogzaad, et al. 2017; Schneider, Füssler, Kohli, et al. 2017). In this section, we focus the quantitative analysis on the implications for the single target years communicated in NDCs. The analysis differentiates results for NDCs with 2025 targets and 2030 targets, noting that the NDCs of Brazil, Gambia and South Africa provide targets for both years.

The analysis is based on country-level data, which is derived from two main sources. Information on historical GHG emissions, on BAU emissions projections, and on the quantification of countries' targets is drawn from Climate Action Tracker (2015). The data from Climate Action Tracker is used because it provides independent BAU emissions projections that are consistent with our definition of BAU (see Section 3.2.4), that are derived from specific information from the country, and that are coherently applied across countries. The 2015 data approximately reflects the policies that were in place at the time countries set their targets – in line with the definition of BAU outlined. The 2015 data, however, partially relies on data sources prior to 2015, such as IEA (2015), which provides estimates made in earlier years.

Historical and projected GDP values were drawn from U.S. Department of Agriculture's Economic Research Service (2017), which in turn builds its estimates on the basis of data by the World Bank, the International Monetary Fund, and others. The emissions intensity (i.e. GHG emissions per GDP) was calculated by dividing the historical and projected GHG emissions data from Climate Action Tracker (CAT) by the historical and projected GDP data from USDA-ERS.

A few issues in the data had to be addressed. A full dataset for historical GHG emissions in the 2003–2012 period is required for the calculations; gaps in the 2015 Climate Action Tracker data were filled with data from Climate Action Tracker (2017) and, where still missing, with data from WRI (2017). As historical GHG emissions sometimes diverge by a few percentage points from the Climate Action Tracker (2015) data, adjustments were made to the Climate Action Tracker (2017) and WRI (2017) data so as to ensure that they are consistent with the historical time series of the Climate Action Tracker (2015) data. Also, where CAT provided BAU emissions projections as a range, the comparison between relative limits and BAU projections was made with respect to the average. Adjustments were necessary also to address discrepancies in emissions intensity data.

For one country (Ukraine), the combination of CAT and USDA-ERS data to calculate projections of emissions intensity produced results that point to inconsistencies across the data sources. In particular, the economic downturn experienced by Ukraine since 2014 is not reflected in the sources on which CAT based its BAU projections. The downturn is, however, reflected in the USDA-ERS data – thus generating an artificial step in calculations that combine both data sources. The country was thus disregarded from analyses of specific limits based on the GHG emissions intensity.

6.2.3 NDC targets of the assessed countries

In this section, we provide an overview of the pledged mitigation – and the amount of hot air – for the selected countries under three scenarios: a high mitigation scenario and a low mitigation scenario, as in Section 3.4, and – in addition – an average scenario. In the average scenario, we compare the average value between the highest and the lowest target level with the average value between the highest and the lowest BAU projection. The average scenario is thus not based on a country's specific target, but instead presents an average estimate of pledged mitigation.

For the 17 selected countries, Table 7 shows the outcome from these three scenarios for the target years 2025 and 2030. The table shows that the level of pledged mitigation and hot air differs strongly among the three scenarios:

Table 7: Pledged mitigation of the assessed countries under different scenarios, relative to BAU emissions projections by Climate Action Tracker ($MtCO_2e$)

		BAU emissions level			NDC target level			Mitigation outcome / "hot air" ($MtCO_2e$)			Mitigation outcome / "hot air" (%)		
		Lower level	Average level	Higher level	Lower level	Average level	Higher level	High mitigation	Average	Low mitigation	High mitigation	Average	Low mitigation
NDCs with 2025 targets	Brazil	1,214	1,214	1,214	1,164	1,169	1,174	-50	-45	-40	-4%	-4%	-3%
	Gambia	3	3	3	2	3	3	-1	-1	-0	-43%	-23%	-2%
	South Africa	836	836	836	417	525	633	-420	-312	-204	-50%	-37%	-24%
	United States	6,651	6,742	6,833	5,014	5,248	5,482	-1,820	-1,494	-1,169	-27%	-22%	-18%
	Total mitigation							-2,291	-1,852	-1,413	-26%	-21%	-16%
	Total "hot air"							0	0	0	0%	0%	0%
NDCs with 2030 targets	Argentina	430	515	600	432	482	532	-168	-33	102	-28%	-6%	24%
	Brazil	1,299	1,299	1,299	1,218	1,228	1,237	-80	-71	-62	-6%	-5%	-5%
	China	13,306	13,870	14,435	13,588	15,264	16,940	-848	1,393	3,634	-6%	10%	27%
	Ethiopia	310	310	310	185	185	185	-125	-125	-125	-40%	-40%	-40%
	EU	3,681	3,999	4,317	3,379	3,484	3,589	-937	-514	-91	-22%	-13%	-2%
	Gambia	4	4	4	2	3	4	-2	-1	-0	-45%	-23%	-1%
	India	5,360	5,410	5,459	5,306	5,695	6,083	-153	285	723	-3%	5%	13%
	Indonesia	1,086	1,086	1,086	1,195	1,316	1,438	109	230	352	10%	21%	32%
	Japan	1,145	1,208	1,272	1,079	1,079	1,079	-192	-129	-66	-15%	-11%	-6%
	New Zealand	85	85	85	54	54	54	-31	-31	-31	-37%	-37%	-37%
	Norway	52	52	52	20	25	30	-32	-27	-22	-62%	-52%	-42%
	Peru	139	139	139	97	109	121	-42	-30	-18	-30%	-22%	-13%
	Russia	2,624	2,639	2,654	2,986	3,074	3,163	332	435	539	13%	17%	21%
	South Africa	943	943	943	417	525	633	-527	-419	-311	-56%	-44%	-33%
	South Korea	669	732	796	536	536	536	-260	-196	-133	-33%	-27%	-20%
	Ukraine	533	654	776	556	556	556	-220	-99	23	-28%	-15%	4%
	Total mitigation							-3,618	-1,676	-859	-11%	-5%	-3%
	Total "hot air"							441	2,344	5,373	1%	7%	17%

Source: Calculations based on Climate Action Tracker (2015).

- In the **high mitigation scenario**, all countries, except for two, have NDC targets – in 2030, 2025 or both – that are more stringent than the BAU emissions projection. Fourteen countries have 2030 targets more stringent than BAU; their total pledged mitigation is about 3.6 $GtCO_2e$, corresponding to a reduction of about 11% compared to the high BAU emissions projection. The total amount of hot air from the two countries with 2030 NDC targets less stringent than BAU amounts to 441 $MtCO_2e$. In this scenario, the total amount of hot air is about 12% of the total pledged mitigation by countries with targets more stringent than BAU.

- In the **average scenario**, 13 out of the 17 countries have NDC targets more stringent than BAU. Four have NDC targets less stringent than BAU – and could thus transfer hot air. For the 12 countries with 2030 NDC targets more stringent than BAU, the total pledged mitigation is about 1.7 $GtCO_2e$, corresponding to a reduction of about 5% compared to the average BAU emissions projection. For the four countries with 2030 NDC targets less stringent than BAU, the total amount of hot air amounts to about 2.3 $GtCO_2e$. In this scenario, the volume of hot air thus exceeds the total mitigation action by countries with targets more stringent than BAU.

- In the **low mitigation scenario**, 11 countries have mitigation targets that are more stringent than BAU, whereas six countries have NDC targets less stringent than BAU. For the 10 countries with 2030 NDC targets more stringent than BAU, the total pledged mitigation is about 860 $MtCO_2e$, corresponding to a reduction of about 3% compared to the low BAU emissions projection. For the six countries with 2030 NDC targets less stringent than BAU, the total amount of hot air amounts to about 5.4 $GtCO_2e$. In this scenario, the amount of hot air significantly exceeds the total pledged mitigation by countries with targets more stringent than BAU.

6.2.4 Results for relative limits

Eight different approaches for establishing relative limits were tested for all countries. Table 8 outlines the results for each country. For each relative limit approach, the table presents the deviation of the relative limit from the *average* projected BAU emissions in the NDC target year. The lower the deviation is, the better the approach approximates BAU emissions projections.

A *positive* value denotes a situation where the relative limit lies *above* (i.e. is less stringent than) the projected BAU emissions in that year. A *negative* value denotes a situation where the relative limit lies *below* (i.e. is more stringent than) the projected BAU emissions in that year. Information on the range of BAU emissions projections by Climate Action Tracker is also provided, thereby highlighting the variation contained in the BAU projection data. Finally, Table 8 also presents the relative difference between the NDC target level and the projected BAU for the average scenario; negative values mean that the NDC target is more stringent than BAU.

The table shows that the calculated relative limits often differ significantly from the BAU emissions projected by Climate Action Tracker. The results are rather dispersed, with some limits lying far above, and some far below the BAU emissions projections. None of the approaches provides for a good approximation of BAU projections for all countries, and often the difference between the relative limit and BAU is larger than the difference between BAU and the NDC. This implies that the approaches do not achieve the objective of preventing the transfers of hot air while enabling ITMO transfers that result from mitigation actions.

As highlighted above, BAU projections are uncertain. Part of the large variation between relative limits and BAU projections may be due to the BAU projections themselves. However, the results also show that different approaches to establish limits lead to strongly differing results for the same country. For example, in the case of several countries, relative limits based on trends of *GHG emissions* strongly differ from relative limits based on trends of *GHG emissions per GDP*.

Among the eight tested approaches for establishing relative limits, the best at approximating BAU projections is one that uses relative limits based on the average of historical GHG emissions, as can be seen from the standard deviations presented in Table 8. No significant differences in the results were found between 3-year averages and 5-year averages.

Table 8: Deviation of relative limits from BAU emissions projections

		Range of BAU projection (CAT)	NDC compared to BAU (avg. scenario) (CAT)	Historical GHG emissions				Historical emissions per GDP			
				Average		Trend		Average		Trend	
				3 yrs	5 yrs	5 yr	10 yrs	3 yrs	5 yrs	5 yrs	10 yrs
NDCs with 2025 targets	Brazil	Single point	-4%	-18%	-20%	+8%	+7%	+1%	+2%	-18%	-25%
	Gambia	Single point	-23%	-32%	-36%	+30%	+15%	+20%	+15%	+87%	+62%
	South Africa	Single point	-37%	-31%	-32%	-23%	-17%	-9%	-8%	-23%	-33%
	United States	+/- 1%	-22%	-1%	+0%	-25%	-16%	+34%	+37%	-20%	-14%
NDCs with 2030 targets	Argentina	+/- 14%	-6%	-35%	-35%	-39%	-22%	+2%	+9%	-214%	-212%
	Brazil	Single point	-5%	-23%	-25%	+10%	+8%	+6%	+8%	-21%	-31%
	China	+/- 4%	+10%	-24%	-28%	+54%	+49%	+123%	+130%	-23%	-72%
	Ethiopia	Single point	-40%	-70%	-70%	-61%	-54%	-5%	+4%	-272%	-281%
	EU	+/- 7%	-13%	+16%	+18%	-30%	-24%	+54%	+57%	-11%	-37%
	Gambia	Single point	-23%	-42%	-46%	+30%	+13%	+30%	+25%	+129%	+92%
	India	+/- 1%	+5%	-54%	-56%	-13%	-16%	+74%	+79%	-10%	-14%
	Indonesia	Single point	+21%	-36%	-39%	+17%	-6%	+66%	+68%	+29%	-36%
	Japan	+/- 5%	-11%	+8%	+6%	+43%	-6%	+25%	+23%	+56%	-3%
	New Zealand	Single point	-37%	-13%	-13%	-10%	-21%	+37%	+39%	+2%	-21%
	Norway	Single point	-52%	+2%	+2%	-5%	-8%	+45%	+45%	+15%	-11%
	Peru	Single point	-22%	-43%	-44%	-20%	-21%	+18%	+23%	-64%	-96%
	Russia	+/- 1%	+17%	-14%	-15%	+4%	-2%	+10%	+10%	-1%	-68%
	South Africa	Single point	-44%	-39%	-39%	-29%	-22%	-11%	-10%	-29%	-43%
	South Korea	+/- 8%	-27%	-8%	-12%	+63%	+34%	+47%	+45%	+65%	+11%
	Ukraine	+/- 16%	-15%	-39%	-39%	-43%	-55%				
Standard deviation for 2025 NDCs				0.14	0.16	0.26	0.16	0.19	0.19	0.54	0.44
Standard deviation for 2030 NDCs				0.24	0.24	0.36	0.28	0.35	0.37	0.89	0.81

Source: Calculations based on Climate Action Tracker (2015).
Note: Ukraine excluded from analysis of emissions per GDP due to data inconsistencies. See Section 6.2.2.

6.2.4.1 Relative limits based on the average of historical GHG emissions

Relative limits based on *averages* of historical GHG emissions preceding the establishment of the target – in this case the average of historical emissions in the period 2010 to 2012 – are good proxies for BAU emissions for those countries where BAU emissions are projected to remain at current levels, such as in the case of Norway (see Figure 7).

For countries with increasing or decreasing emissions trends, however, this type of limit would not achieve the objective of preventing hot air while enabling transfers of ITMOs that result from mitigation action. The results of the approach, however, differ strongly between countries with increasing and decreasing emissions trends:

- **Countries with increasing emissions trends**: Among the 17 countries tested, 14 are projected to have increasing emissions trends in the average scenario. Four out of these 14

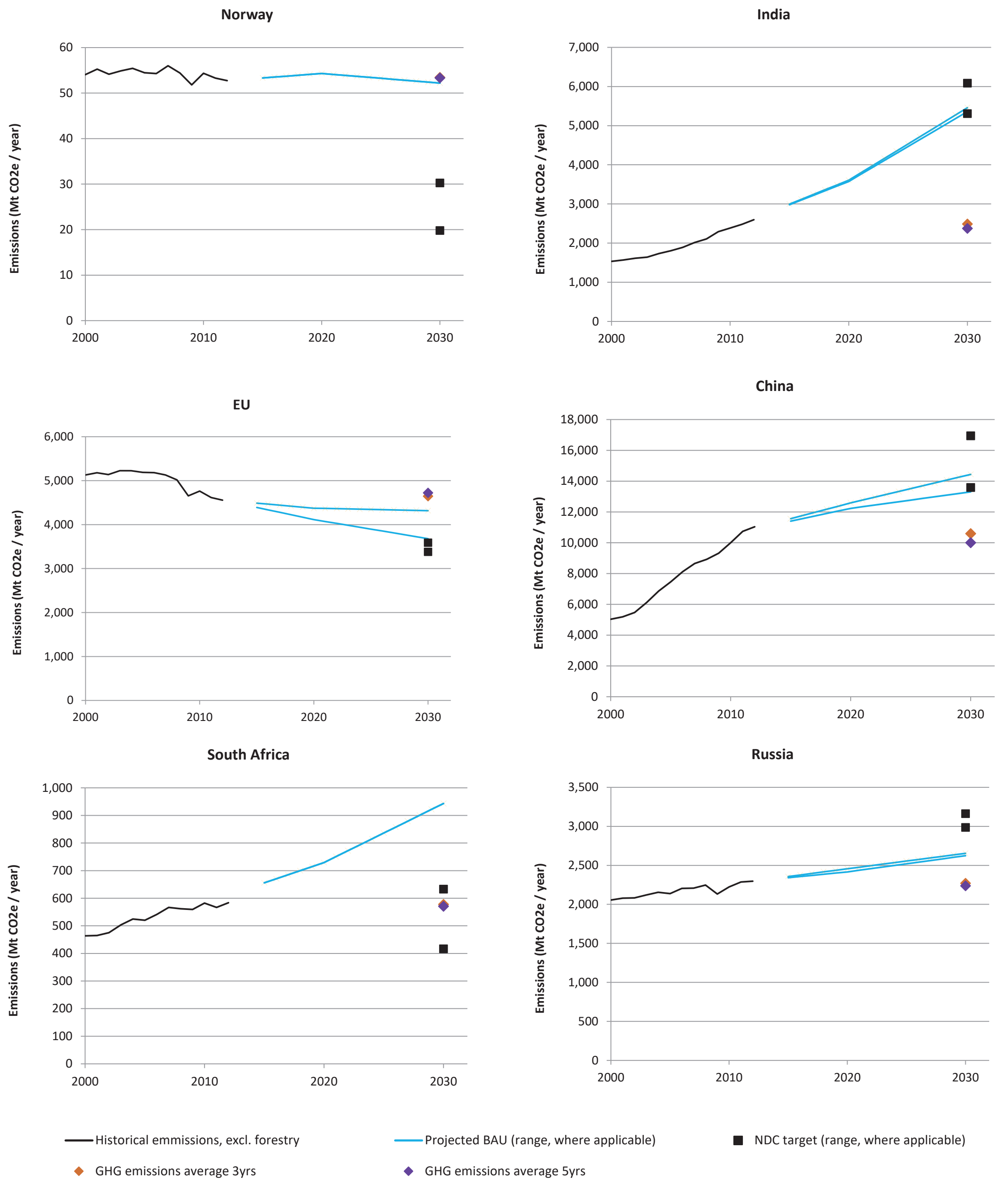

Figure 7: Relative limits based on the average of historical GHG emissions
Source: Calculations based on Climate Action Tracker (2015).

countries have NDC targets less stringent than BAU projections. For these countries, the approach effectively prevents the transfer of hot air. Nine out of the remaining 10 countries with increasing GHG emissions, however, have an NDC target that is more stringent than BAU projections. For these countries, this type of limit could make it difficult to engage in international transfers; they would have to reduce emissions far below their NDC target before being able to engage in international ITMO transfers. India, for example, would have to reduce its emissions by nearly 3 $GtCO_2e$ below the projected BAU emissions in 2030 before it could transfer any ITMOs (see Table 8). As many developing countries have increasing emissions trends, a limit based on the average of historical GHG emissions could thus impose severe restrictions on their ability to engage in international transfers – even when they reduce emissions below BAU.

- **Countries with decreasing emissions trends**: By contrast, for countries with decreasing trends, a limit based on GHG emission averages will lie above BAU projections. The environmental implication depends on the level of the NDC target. For countries with decreasing emissions and NDC targets more stringent than BAU, a relative limit based on average historical emissions would be of no consequence: assuming the country achieves its NDC target, it would only be able to transfer ITMOs to the extent that it reduces emissions below the NDC target level. This situation applies to all three tested countries with decreasing emissions trends. For countries with decreasing emissions and NDC targets less stringent than BAU, however, this approach would allow for the transfer of hot air. This latter scenario, although not present in the countries tested here, could occur for other countries or in future NDCs if more countries get on decreasing emission pathways.

For the countries tested, no significant differences in the results were found between 3-year averages and 5-year averages.

6.2.4.2 Relative limits based on trends of historical GHG emissions

Relative limits based on trends of historical GHG emissions reflect increasing or decreasing GHG emissions trends. They are good approximations for BAU emissions projections for the few countries where the rate of increase or decrease in emissions is expected to stay stable over time, such as in the case of Russia (see Figure 8). Yet this approach quickly loses accuracy when countries' rates changes over time – which is the case for most other countries analysed here. China, for example, has increasing emissions trends – but CAT projects that the rate of increase will be lower in the future than it has been historically. In this case, the relative limit lies far above BAU emissions projections, which means that China would be able to transfer hot air. The opposite seems to be true for Peru, where CAT expects emissions to increase more quickly than they did historically, and for which a relative limit based on GHG emissions trends could be overly conservative.

Overall, this method would fully prevent the transfer of hot air only for one (India) out of the four countries with hot air in the average scenario. For Russia and Indonesia, the 10-year trend would prevent the transfer of hot air, whereas the 5-year trend would allow some hot air to be transferred. China would be able to transfer all hot air under both the 5-year and the 10-year trend approaches.

The results are mixed for countries with NDC targets more stringent than BAU. Roughly half of developing countries analysed would have relative limits far above BAU, while the other half would have relative limits far below BAU. The results are also mixed for developed countries that were analysed. The EU, New Zealand, Norway and the United States would have relative limits below BAU; Japan, however, would see both relative limits below BAU (for a 10-year reference period) and above BAU (for a five-year reference period). In the case of South Korea, the relative limits would be far above BAU (see Table 8).

Somewhat surprisingly, relative limits based on *trends* of GHG emissions fared worse than relative limits based on *averages* of GHG emissions. For relative limits based on trends of historical emissions, the period of calculation was found to have a very significant impact for some countries, such as Japan, whereas the difference between 5-year and 10-year trends was small for other countries, such as Peru or China. Overall, the 10-year trend gave less dispersed results than the 5-year trend. A possible explanation is that the effect of the 2008/2009 financial crisis – which caused significant changes to GHG emissions – has less impact for 10-year trends than for 5-year trends. Trends calculated over short time frames can more accurately reflect recent changes to emission patterns, but are less resilient to short-term deviations from long-term emission pathways, such as deviations due to economic or weather conditions. By contrast, trends calculated over longer periods of time are more resilient to such short-term changes but much slower in reflecting more recent changes in emission patterns.

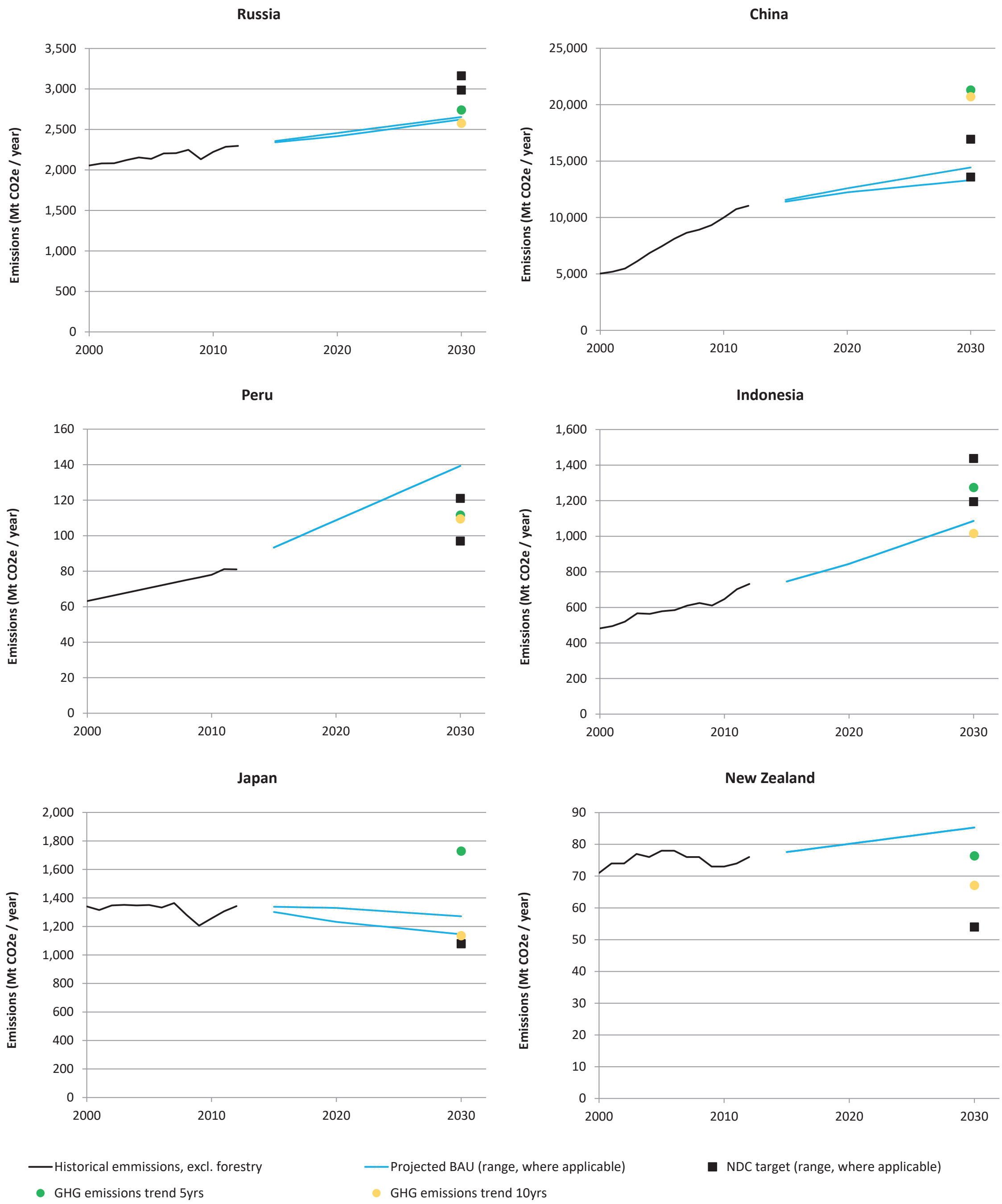

Figure 8: Relative limits based on trends of historical GHG emissions

Source: Calculations based on Climate Action Tracker (2015).

6.2.4.3 Relative limits based on the average of historical emissions intensity

Relative limits based on the *average* of historical emissions *intensity* (i.e. GHG emissions per GDP) are above BAU projections for nearly all countries assessed, indicating that most countries have reduced emissions intensity. This approach results in limits close to BAU projections for countries like Brazil; it lies far above projections for countries like China, the EU and New Zealand (see Figure 9). Relative limits based on the average of historical emissions *intensity* fared worse than limits based on the average of historical GHG *emissions*, and all four countries with NDC targets less stringent than BAU would be able to transfer some or all of their hot air. For countries with NDC targets more stringent than BAU, the impact is very limited, as the limit does not lie below their NDC targets. Here again, no significant difference was identified in the results of 3-year versus 5-year reference periods.

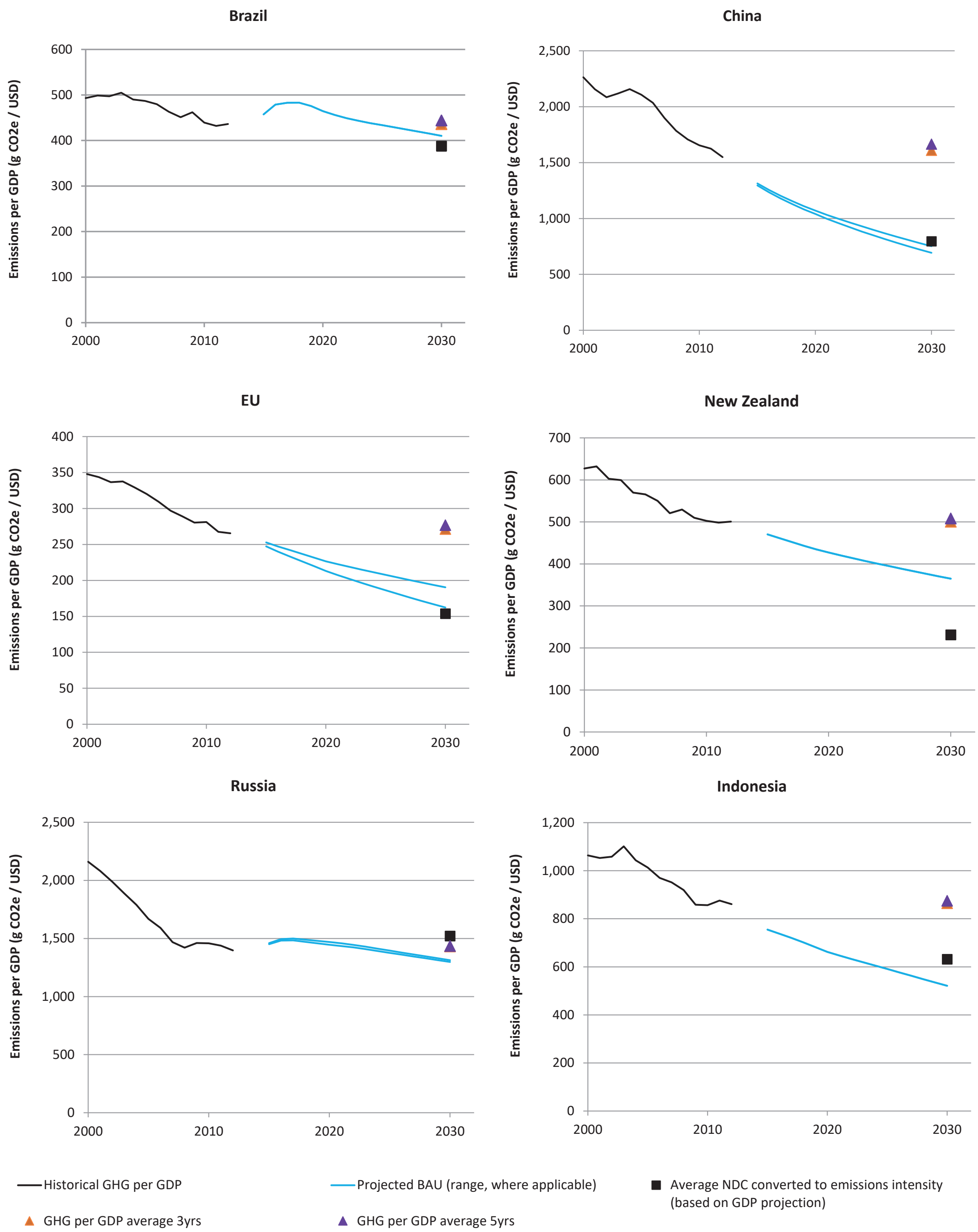

Figure 9: Relative limits based on the average of historical emissions intensity

Source: Calculations based on Climate Action Tracker (2015).

6.2.4.4 Relative limits based on trends of historical emissions intensity

The emissions intensity per GDP is decreasing for most countries, and relative limits based on trends of historical emissions intensity could potentially reflect this development. Much like relative limits based on trends of historical emissions, the suitability of this approach depends on how countries' rate of emissions intensity changes over time. In India, the rate is expected to stay relatively constant until 2030, and relative limits based on trends of historical emissions intensity lie just below the projected emissions intensity (Figure 10). In the EU and China, however, the rate of change in emissions intensity is expected to lower over time, causing relative limits based on historical trends to fall well below the projected BAU. In the case of Gambia, the direction of

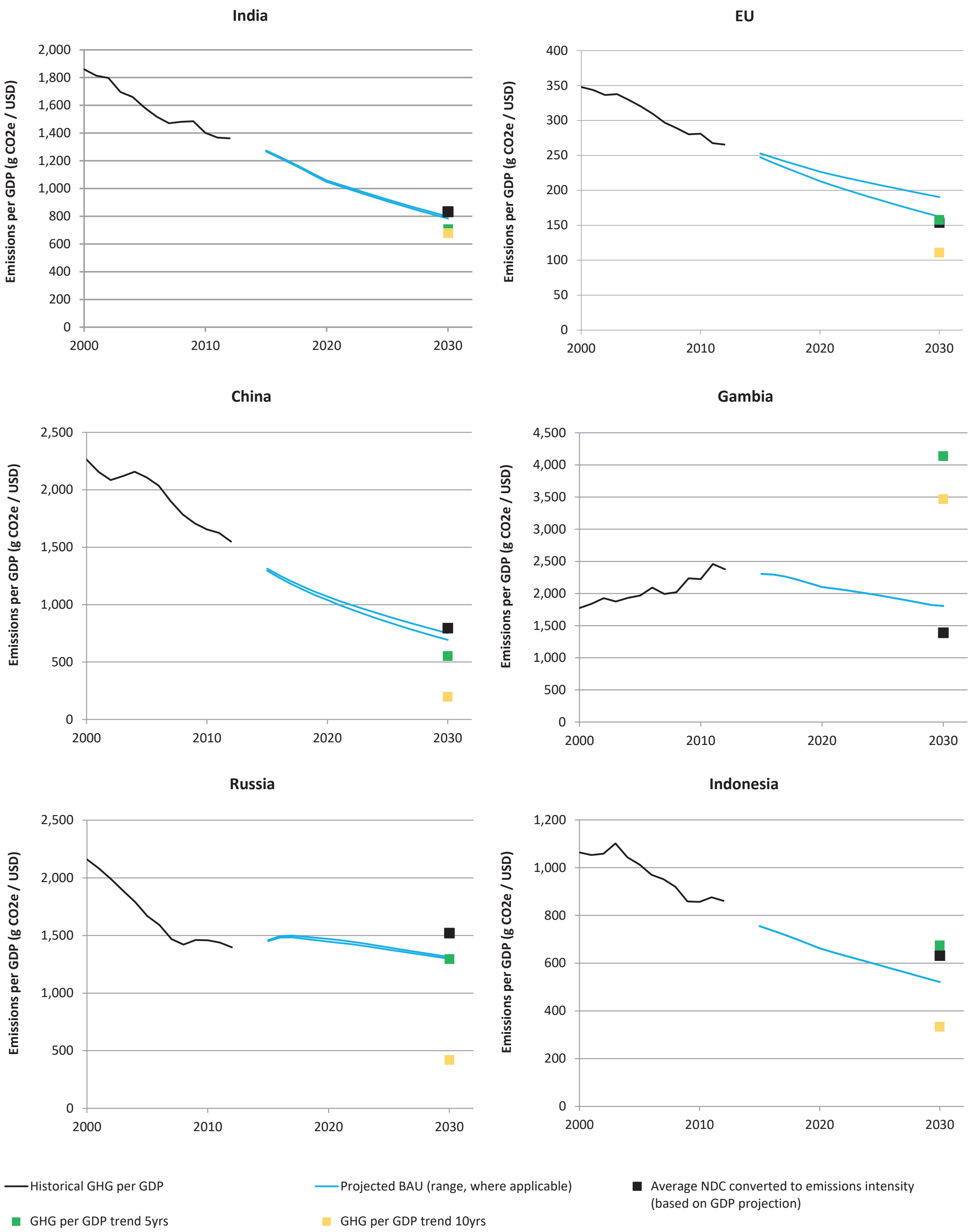

Figure 10: Relative limits based on trends of historical emissions intensity

Source: Calculations based on Climate Action Tracker (2015).

the trend changes: historically, the emissions intensity increased over time, but is expected to decrease in the future. In this case, using historical trends leads to a relative limit far above projected BAU emissions intensity.

On average, reference levels based on trends of emissions intensity are the worst performing option among all reference levels tested in terms of their suitability as an approximation of BAU levels. This approach would prevent hot air transfers from three out of the four countries with NDC targets less stringent than BAU in the average scenario. For Indonesia, the 10-year emission intensity trend would prevent hot air transfers, whereas the 5-year one would allow the country to transfer all of its hot air volume. For the eleven countries with NDC targets more stringent than BAU, the results are mixed. For four of them, the relative limit would lie significantly below the NDC target, such that international transfers would be possible only if emissions were reduced significantly below the NDC level. For two other countries, the relative limit lies below BAU emission intensity projections, but partially overlaps with the NDC range. For two countries, the relative limit lies above BAU emissions projections. For the remaining three, the result depends on the reference period, with the 10-year trend values lying below projected BAU and the 5-year ones lying above BAU. Indeed, for several countries, the reference period chosen – i.e. 5 or 10 years – has a large impact.

6.2.5 Results for absolute limits

Absolute limits restrict the absolute amount of ITMOs that a country can transfer. To assess the implications of absolute limits, six different approaches were applied to the 17 countries selected for testing. Table 9 shows, for the three scenarios, the extent to which the six approaches allow or prevent the transfer of hot air. The table shows that the results differ between the approaches and – more strongly – between the three scenarios.

A limit of 1% of the countries' GHG emissions or their NDC target levels would prevent more than 90% of the total volume of hot air from being transferred (Table 9). In the high mitigation scenario, for example, two countries have NDC targets less stringent than BAU emissions projections, amounting to 441 $MtCO_2e$ of hot air in 2030. Of these 441 $MtCO_2e$, only 30–42 $MtCO_2e$ could be transferred under the various 1% absolute limit options. In the average scenario and with a 1% limit, the four countries with NDC targets less stringent than BAU could transfer 160–253 $MtCO_2e$ of hot air. In the low mitigation scenario, it increases to 168-287 $MtCO_2e$. Under a 5% limit, the amounts would be respectively larger, enabling between 148 and 1,431 $MtCO_2e$ of hot air to be transferred under the various limit options and scenarios.

Absolute limits could affect countries' ability to engage in international transfers. The ability to transfer is impacted mainly by the threshold applied but also by how many countries would be

Table 9: Amount of hot air that can be transferred in 2030 under various absolute limits

	High mitigation scenario		Average scenario		Low mitigation scenario	
	$MtCO_2e$	%	$MtCO_2e$	%	$MtCO_2e$	%
Number of countries with hot air	2		4		6	
Amount of hot air	441	100%	2,344	100%	5,373	100%
1% limit based on 2010-2012 emissions	30	7%	160	7%	168	3%
5% limit based on 2010-2012 emissions	148	34%	802	34%	839	16%
1% limit based on pre-target year emissions	39	9%	233	10%	259	5%
5% limit based on pre-target year emissions	194	44%	1,167	50%	1,285	24%
1% limit based on NDC target level	42	9%	253	11%	287	5%
5% limit based on NDC target level	209	47%	1,267	54%	1,431	27%

Source: Calculations based on Climate Action Tracker (2015).
Note: The analysis includes the 16 analysed countries with 2030 NDC targets

transferring countries and how many would be acquiring countries. If countries representing half of global GHG emissions are transferring countries, a 1% limit in 2030 would imply a total global potential for ITMO transfers of about 250 million in 2030. A 5% limit would imply that a total of about 1,250 million ITMOs could be transferred globally.

Absolute limits on the basis of NDC target levels could generate perverse incentives for countries to set less ambitious NDC targets. On the other hand, limits based on pre-target year emissions could provide disincentives for countries to over-achieve their NDC targets, as this would affect the limit applicable to the subsequent period.

6.2.5.1 Absolute limits based on GHG emissions

Table 10 illustrates the level of absolute limits based on GHG emissions for the 17 analysed countries. The effectiveness of these limits strongly depends on the threshold chosen. As discussed above, a 1% threshold prevents a large fraction the hot air from being transferred, whereas a 5%

Table 10: Absolute limits based on GHG emissions for analysed countries ($MtCO_2e$)

		Amount of "hot air"			Limits based on average 2010-2012 emissions		Limits based on pre-target year emissions					
		High mitigation	Average	Low mitigation			High mitigation		Average		Low mitigation	
					1%	5%	1%	5%	1%	5%	1%	5%
2025 NDCs	Brazil	-50	-45	-40	10	50	10	48	10	50	10	52
	Gambia	-1	-1	-0	0	0	0	0	0	0	0	0
	South Africa	-420	-312	-204	6	29	4	21	5	26	6	30
	United States	-1,820	-1,494	-1,169	67	334	59	296	60	298	60	301
2030 NDCs	Argentina	-168	-33	102	3	17	4	21	5	23	5	24
	Brazil	-80	-71	-62	10	50	12	59	12	59	12	59
	China	-848	1,393	3,634	106	530	134	672	144	722	155	773
	Ethiopia	-125	-125	-125	1	5	2	8	2	8	2	8
	EU	-937	-514	-91	46	232	38	191	39	195	40	198
	Gambia	-2	-1	-0	0	0	0	0	0	0	0	0
	India	-153	285	723	25	124	46	231	49	245	52	259
	Indonesia	109	230	352	7	35	11	53	11	57	12	61
	Japan	-192	-129	-66	13	65	12	60	12	60	12	60
	New Zealand	-31	-31	-31	1	4	1	3	1	3	1	3
	Norway	-32	-27	-22	1	3	0	1	0	1	0	2
	Peru	-42	-30	-18	1	4	1	5	1	5	1	6
	Russia	332	435	539	23	113	28	140	29	143	29	145
	South Africa	-527	-419	-311	6	29	4	21	5	26	6	32
	South Korea	-260	-196	-133	7	34	5	27	5	27	5	27
	Ukraine	-220	-99	23	4	20	6	31	6	31	6	31

Source: Calculations based on Climate Action Tracker (2015).

threshold allows a large amount of the available hot air to be transferred. Generally, the period used for setting the threshold has much less impact than the threshold value.

6.2.5.2 Absolute limits based on NDC target levels

Table 11 illustrates the level of absolute limits based on NDC target levels for the 17 analysed countries. The results for this type of limits are similar than those for absolute limits based on GHG emissions. The effectiveness also strongly depends on the threshold chosen, with the 1% threshold being more effective than the 5% threshold.

Table 11: Absolute limits based on NDC target levels (MtCO_2e)

		Amount of "hot air"			Limits based on NDC target level					
		High mitigation	Average	Low mitigation	High mitigation		Average		Low mitigation	
					1%	5%	1%	5%	1%	5%
2025 NDCs	Brazil	-50	-45	-40	12	58	12	58	12	59
	Gambia	-1	-1	-0	0	0	0	0	0	0
	South Africa	-420	-312	-204	4	21	5	26	6	32
	United States	-1,820	-1,494	-1,169	50	251	52	262	55	274
2030 NDCs	Argentina	-168	-33	102	4	22	5	24	5	27
	Brazil	-80	-71	-62	12	61	12	61	12	62
	China	-848	1,393	3,634	136	679	153	763	169	847
	Ethiopia	-125	-125	-125	2	9	2	9	2	9
	EU	-937	-514	-91	34	169	35	174	36	179
	Gambia	-2	-1	-0	0	0	0	0	0	0
	India	-153	285	723	53	265	57	285	61	304
	Indonesia	109	230	352	12	60	13	66	14	72
	Japan	-192	-129	-66	11	54	11	54	11	54
	New Zealand	-31	-31	-31	1	3	1	3	1	3
	Norway	-32	-27	-22	0	1	0	1	0	2
	Peru	-42	-30	-18	1	5	1	5	1	6
	Russia	332	435	539	30	149	31	154	32	158
	South Africa	-527	-419	-311	4	21	5	26	6	32
	South Korea	-260	-196	-133	5	27	5	27	5	27
	Ukraine	-220	-99	23	6	28	6	28	6	28

Source: Calculations based on Climate Action Tracker (2015).

7 ENSURING UNIT QUALITY IN INTERNATIONAL TRANSFERS

International transfers of ITMOs can be backed by flows of units issued under carbon market mechanisms, such as for international linking of ETSs or international crediting mechanisms. If these units have quality – and if robust accounting is applied and the possibility to participate in mechanisms does not provide disincentives for future mitigation action –, then the environmental integrity is safeguarded, regardless of the level of ambition of the transferring country (see Section 2.2). Units have quality if the underlying mechanism ensures that the issuance or transfer directly is directly associated with an emission reduction of at least 1 tCO_2e in the transferring country, compared to the situation in the absence of the mechanism.

Drawing upon earlier research (Schneider, Füssler, La Hoz Theuer, et al. 2017), we discuss in this section options for facilitating unit quality under Article 6.2, notably: procedures for reporting and review on how countries ensure unit quality; the establishment of international guidance on unit quality and mechanism design; and eligibility criteria for mechanisms. Options that lie outside the purview of the UNFCCC – such as political declarations, carbon clubs, green investment schemes and exchange or discount rates – are also briefly addressed. These options are not mutually exclusive, and some could also be applicable to the Article 6.4 mechanism.

7.1 Reporting and review

A number of Parties argue that neither the Paris Agreement nor its accompanying decision establish mandates for the elaboration of international rules on environmental integrity under Article 6.2. These Parties also argue that the safeguarding of environmental integrity under Article 6.2 lies under the prerogative of the countries involved in an international transfer. Under such an interpretation, Parties would be responsible for ensuring environmental integrity in cooperative approaches based on requirements already present in the Paris Agreement. Parties would then report on their implementation of these requirements.

This approach would strongly rely on "transparency" in order to ensure environmental integrity and unit quality. Transparency provisions can help build trust and confidence among Parties by casting light on Parties' implementation efforts, helping identify opportunities to enhance such efforts, and holding Parties accountable for meeting their commitments (van Asselt 2016). "Ensuring transparency, including in governance" in Parties' activities under Article 6.2 could, moreover, be understood to include transparency with regard to the use, design and operation of international carbon market mechanisms. Moreover, if countries were to engage in bilateral government-to-government transfers that are not be backed by mechanisms, then transparency provisions could be key in providing incentives for countries to ensure environmental integrity.

The effectiveness of this approach in promoting the quality of units hinges on several key elements:

1. A clear understanding of the requirements to be followed – i.e. what it means to "ensure environmental integrity" and to "ensure transparency" when engaging in cooperative actions;

2. Availability of sufficient information by Parties in their reporting, such that any shortcomings in the quality of units be identifiable by a review process;

3. A credible review process that is mandated and able to identify environmental integrity shortcomings in Parties' activities under Article 6.2; and

4. The successful implementation of corrective measures by Parties to address any identified shortcomings.

Several challenges stand in the way of fulfilling the conditions outlined above. The Paris Agreement does not, for example, define environmental integrity, neither in general terms nor in the context of carbon markets (see Section 2.1). It is also unclear what is meant by "ensuring transparency, including in governance". Precise definitions – such as the ones on environmental integrity and unit quality proposed in Section 2 – could be required for this approach to be effective in ensuring the quality of units transferred internationally.

An agreement would also be necessary on the reporting process. This could be done through the provisions of Article 13.7(b) – which requires Parties to report "information necessary to track progress made in implementing and achieving its nationally determined contribution under Article 4" – e.g. by including in the modalities, procedures and guidelines referred to in Article 13.13 a requirement that Parties provide information on the use, design and operation of carbon market mechanisms, including on how the quality of units is ensured. Requirements to provide information before transfers are executed could provide incentives for countries to establish or use carbon market mechanisms that ensure unit quality. Such requirements could, for example, require countries to declare their intended use of Article 6.2 – including an estimate of how many units they intend to transfer, how they will transfer them and how they will ensure unit quality. Ex post reporting requirements could then include information on how many units were transferred, to whom, and how, as well as information on how unit quality was ensured. Ex post information should be sufficiently detailed to allow review teams to identify any shortcomings. Rules under Articles 6 and 13, however, are still in the early stages of development. It is not yet clear whether reporting obligations stemming from Article 6.2 would indeed be included under Article 13.7(b), nor is it clear whether the modalities, procedures and guidelines would contain the necessary information requirements.

The review process could be carried out as part of the technical expert review referred to in Article 13.11. Review teams should possess relevant knowledge and experience so as to assess whether Parties adhere to the obligation in ensuring environmental integrity – particularly with regards to the quality of units transferred. Review teams should also have a clear mandate to assess the quality of transferred units according to clear and falsifiable definitions. Here again, negotiations under Articles 6 and 13 have yet to define whether and how such a review would be conducted, and the current level of clarity on the requirements under 6.2 may prove itself inadequate.

The implementation of corrective measures brings about another important challenge in the effectiveness of this approach. Article 15 establishes a "mechanism to facilitate implementation of and promote compliance with the provisions of" the Paris Agreement. Ensuring environmental integrity under Article 6.2 is a "shall" requirement, and it is thus likely that Parties' implementation of this obligation will be included under Article 15. Yet Article 15 is to be facilitative, non-adversarial and non-punitive, and is therefore unlikely to enforce ex post corrections of issues identified. This approach would, thus, strongly rely on Parties' willingness to voluntarily address any identified shortcomings.

The discussion above highlights the many challenges towards the effectiveness of this approach in ensuring environmental integrity and unit quality. An effective implementation of this approach may not be dissociable from agreement on more precise definitions and requirements. Another relevant aspect is certainty: even under an ideal implementation, the reporting and review of currently formulated 6.2 requirements would not provide ex ante assurance of environmental integrity. This approach can *facilitate* environmental integrity, yet only to the extent that the system allows for "naming and shaming" – and only to the extent that Parties are amenable to improving the design of mechanisms and addressing environmental integrity shortcomings in response to identified issues. Reduced ability within the system to identify instances of non-compliance would further undermine the effectiveness of this approach. Importantly, the current level of elaboration on the requirements for Parties to ensure environmental integrity seems inadequate to enable a successful implementation of this approach. Politically, the feasibility of this approach hinges on the extent to which Parties calling for stronger oversight in international transfers are willing to accept a system wherein the safeguarding of environmental integrity could be left largely to voluntary actions by Parties.

7.2 International guidance on unit quality

International guidance to facilitate unit quality could (a) clarify and further elaborate the requirement to "ensure environmental integrity" and to "ensure transparency, including in governance", and (b) provide specific guidance on the design and implementation of international carbon market mechanisms.

The clarification and elaboration of requirements to ensure environmental integrity and transparency could include definitions for environmental integrity, unit quality and perverse incentives. International guidance on the design and implementation of mechanisms could help ensure that mechanisms generate units that have quality. Such guidance could, for example, be incorporated under a guidance on environmental integrity for Article 6.2. Rules under Article 6.4 could also be seen as a blueprint for the elaboration of other crediting mechanisms, and be taken up voluntarily elsewhere. Finally, guidance for the design of (crediting) schemes could also be adopted under Article 6.4, should it come to encompass non-UNFCCC mechanisms. In order to be effective, international guidance on the design and implementation of mechanisms would then need to be complemented by international reporting and review procedures, as outlined in Section 7.1 above.

In addition to helping ensure that mechanisms generate units that have quality, the guidance could also help ensure that environmental integrity requirements do not strongly diverge between Article 6.2 and 6.4. It could be important to have an equivalent set of basic rules under both Articles to ensure a regulatory level playing field – thereby preventing a situation where less environmentally sound mechanisms under Article 6.2 outcompete a more robust (and therefore more costly) mechanism under Article 6.4 (Michaelowa et al. 2015), and possibly trigger a race to the bottom.

As highlighted in Section 2.2, the provisions that are necessary to ensure the quality of units depend on the type of mechanism. International guidance on the design and implementation of mechanisms may thus have to reflect the different possible mechanism types, including crediting mechanisms, international linking of ETSs, and other types of mechanisms (if applicable). Moreover, such guidance could go to varying levels of detail. One approach could be establishing only principles and generic guidance at international level. This approach, although relatively simple, could lack the necessary clarity to ensure consistency in implementation and could therefore lead to diverging results. Alternatively, more detailed provisions could be included, delineating principles into more specific requirements. An elaboration on the possible content of guidance for the various mechanism types lies outside the scope of this paper, but a brief example is provided below.

For crediting mechanisms, for example, principles and generic guidance could resemble best practices from existing schemes, e.g.:

- Emission reductions should be **additional** to those that would have occurred in the absence of the mechanism;
- Emission reductions should be determined in a **conservative** manner, be **real** and **measurable** and **attributable** to the mitigation action, using internationally approved methodological standards;
- The **length of crediting periods** should not exceed the duration for which emission reductions or removals occur;
- Any **non-permanence** should be addressed through appropriate approaches.

- Mitigation activities and emission reductions should be **audited** by independent third-party entities;
- Credits should be issued ex post upon verification of emission reductions;
- Appropriate **stakeholder consultation** should be conducted;
- **Transparent governance arrangements** should be established for the mechanisms, and information on the mechanism and its activities should be provided in a transparent manner;

For each of these elements, more specific guidance could be provided. For independent third-party audits, for example, more specific guidance could include:

- Mechanisms should establish and maintain an accreditation system for independent third-party auditors, including relevant standards and procedures for accreditation;
- Accreditation standards and processes should ensure that auditors are competent and independent;
- There is regular monitoring of performance of third-party auditors, as well as sanctions for non-performance.

The effectiveness of this approach in ensuring unit quality under Article 6.2 is uncertain and strongly hinges on how specific the guidance is with regard to the design of mechanisms, and how effective the reporting, review and compliance regimes are in identifying shortcomings and remedying them. Politically, the feasibility of this approach hinges on UNFCCC negotiations reaching a middle ground between those that favor a bottom-up implementation of Article 6.2 with very limited international regulation, and those that favor stronger international safeguards on environmental integrity under Article 6.2.

7.3 Eligibility criteria

Participation in international transfers could be subject to eligibility criteria. Eligibility criteria on accounting, for example, could relate to requirements for the accounting of NDCs (Article 4.13), progress in achieving NDCs (13.13) and use of ITMOs towards NDCs (Article 6). Such eligibility criteria could build on the eligibility criteria established under the Kyoto Protocol, which primarily aim to ensure robust accounting.

Eligibility criteria could also be established with the view to ensuring the quality of units. This would require some sort of international approval of the underlying carbon market mechanism. As such, the criteria would not be applicable to countries, but to the mechanisms used to transfer units internationally. The criteria could also be established at the level of specific types of mitigation actions, such as specific project types. The adherence to the eligibility criteria could also be reassessed periodically. Its implementation would require a governance structure – such as the transparency regime or a separate governance structure that would assess mechanisms or types of mitigation actions against the criteria, monitoring compliance and addressing deviations. Eligibility criteria, referred to as "emission unit criteria", are also used by the International Civil Aviation Organization for the operationalization of its Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) (ICAO 2016). Eligibility criteria could build on international guidance on the design and implementation of mechanisms, as discussed in Section 7.2.

In principle, a well-designed set of eligibility criteria for mechanisms, alongside a system that ensures adherence to them, could help ensure unit quality. However, assessing the quality of units from mechanisms operated by Parties could be technically and politically challenging.

7.4 Options outside of UNFCCC

7.4.1 Political commitments

Overall, the environmental integrity risks from hot air depend on the extent to which the hot air volume is met with demand. Currently, only few countries have stated an interest in acquiring international units, and countries' forecasted demand for international units in the period up to 2030 is estimated to be low (Obergassel and Gornik 2015) – although demand might increase once provisions under Article 6 are in place. If there is political will among acquiring countries to ensure environmental integrity, then political commitments might complement rules at international level.

Major potential acquiring countries could, for example, agree not to purchase ITMOs from certain countries, and/or to only purchase ITMOs that are backed by units sourced through (specific) mechanisms that ensure unit quality. This could for example be done in the form of a political declaration, similar to the one made by countries to address the carry-over between the first and second commitment periods of the Kyoto Protocol (see Section 4.2.2).

The effectiveness of this approach, however, hinges crucially on two elements:

1. **Identifying which units have quality**. Addressing a risk usually requires knowing that the risk exists. If acquiring countries are not aware that certain units are subject to quality concerns, then countries are unlikely to be able to act upon it. Two elements are important here: (a) transparency on the ambition of NDC targets, in order to identify the potential of hot air; and (b) transparency on the design and implementation of mechanisms and their ability to ensure unit quality. These two elements, however, are subject to the challenges outlined in Sections 7.1 and 7.2.

2. **Continuous honouring of such political commitments**. This approach would also require that countries' commitments to ensure environmental integrity in units acquired internationally be implemented consistently over time. This is relevant both in the context of changing political landscapes, and in the context of increasing costs of mitigation action. Political declarations to ensure environmental integrity might, notably, speak less loudly than economic interests in acquiring international units at low cost – even if they lead to an increase in global GHG emissions.

7.4.2 Green investment schemes

GISs were used by countries during the first commitment period of the Kyoto Protocol (see Section 4.1.2) and were aimed at investing revenues from sales of AAUs in climate change mitigation, thereby alleviating environmental integrity risks. GISs might also be employed under the Paris Agreement to mitigate concerns over the environmental integrity of international transfers from countries with targets less stringent than BAU.

In order to provide for unit quality, a GIS would have to ensure that:

a. Emission reductions are additional;
b. The volume of emission reductions achieved is equal to or exceeds the amount of units transferred (i.e. a greening ratio of at least 1); and
c. Any non-permanence is addressed.

Such a GIS would, notably, be very similar to a well-designed crediting mechanism, with the main difference being the timing of unit transfers and availability of finance: in the case of GIS the unit transfers would occur before the emission reductions are achieved, whereas in the case of crediting mechanisms credits are only issued once the emission reductions have been achieved (Schneider, Füssler, La Hoz Theuer, et al. 2017). Ensuring a greening ratio of at least 1 could require robust methodological approaches, in particular where GISs finance mitigation measures that do not easily render themselves to quantification. The scheme would also require robust and transparent provisions to ensure that activities funded ex ante are implemented and deliver the necessary emission reductions, alongside corrective provisions for when the necessary amount of emission reductions is not achieved. Ensuring unit quality through GISs could be facilitated with the adoption of an international guidance for mechanisms (see Section 7.2), alongside robust reporting and review provisions on mechanism design and implementation and/or eligibility criteria for mechanisms (see Section 7.1).

The effectiveness of this approach depends on the motivation of the Parties engaged in the transfer to ensure environmental integrity through GISs – and to do so consistently over time. Some motivation may stem from the transparency provisions under Article 13 and compliance provisions under Article 15 – inasmuch as these provisions allow the international community to identify environmental integrity shortcomings and exert pressure effectively, and inasmuch as the countries involved in the transfer are amenable addressing such shortcomings. In addition to transparency of the ambition of the NDC target, this would require transparency in Parties' use of international transfers, as well as transparency and precision in demonstrating how the unit quality was ensured. Ensuring countries' motivation over time is particularly important in the context of GISs, where emission reductions occur only after investments are made – often long after the international transfer took place.

7.4.3 Carbon clubs

Difficulties in reaching agreement on ambitious climate action through the multilateral climate regime have generated growing interest among scholars and policymakers in other cooperation models. Carbon (or climate) clubs – i.e. small groups of countries that choose to cooperate in pursuit of common goals – are a key element in this context. Clubs could facilitate agreement among groups of countries so as to facilitate climate action, incentivize participation through excludable benefits, and impose sanctions to prevent free-riding among group members, among others (Falkner 2015). Where carbon clubs involve carbon market mechanisms – such as the linking of ETS and other international transfers – clubs could contribute to ensuring the quality of internationally transferred units.

Well-designed and ambitious carbon clubs could complement internationally agreed rules under Article 6 by further elaborating and strengthening these rules for their own use. In order to ensure unit quality in international transfers, carbon clubs could, for example, adopt common principles for club members' use of mechanisms and/or establish joint high-quality mechanisms within the group (Schneider, Füssler, La Hoz Theuer, et al. 2017).

Carbon clubs could also target the other dimensions of environmental integrity outlined in Section 2.2 and address hot air risks. They could, for example, ensure ambitious mitigation targets by defining accession criteria for the club, such as through the ambition level of the NDC target and/or a carbon price range (Schneider, Füssler, La Hoz Theuer, et al. 2017) – thereby keeping countries with hot air out of the club. They could also limit and/or prevent international transfers from club members where the members do not comply with the standards and principles of the group. Through accession criteria, excludable benefits and enforcement mechanisms, carbon clubs could also set positive incentives for climate action and reduce perverse incentives for countries to set unambitious targets.

Carbon clubs are, however, exclusionary by definition, and can only provide incentives and enforcement for members of the club. They would not, for example, be in the position of preventing international transfers lacking environmental integrity among non-club members. Moreover, while they can contribute to the dissemination of best practices, there is no assurance that these practices would be taken up by other countries. It is also important to note that having a club provides no assurance of environmental integrity within the club: the effectiveness of a club in ensuring environmental integrity relies on the willingness of club members to ensure environmental integrity, even through changing circumstances. A low-ambition carbon club (e.g. one which allows for transfers of units that lack quality among its members) could undermine the abatement effort within the club (compared to a situation of no trade) and provide a competitive advantage to club members compared to other countries (or clubs) with higher mitigation ambition (Schneider, Füssler, La Hoz Theuer, et al. 2017).

7.4.4 Exchange rates and discounts

Exchange or discount rates have both been proposed as a means to mitigate the risks from units that lack quality, while facilitating international linkage of carbon markets (Schneider, Füssler, La Hoz Theuer, et al. 2017):

- *Exchange rates* have been discussed in the context of international linking of ETSs. If two ETSs agree on an exchange rate, then units from one ETS can be used for compliance in another, but their value is adjusted by a conversion factor, the exchange rate. The rate is symmetric. For example, if one unit from ETS A has a compliance value of 0.8 in ETS B, then a unit from ETS B has the compliance value of 1.25 (1/0.8) in ETS A; in other words, each ton transferred from ETS B counts for 1.25 tons in ETS A.

- *Discount rates* have been discussed both in the context of linking ETSs and crediting mechanisms. In the context of ETSs, discount rates are similar to exchange rates, but are not symmetrical and lead only to a reduction in compliance values. In the context of crediting mechanisms, discount rates reduce the amount of emissions credited or used towards compliance obligations. France, for example, introduced a general 10% discount on domestic JI projects such that only 90% of the emission reductions from JI projects were issued as ERUs.

Exchange rates might be employed, for example, to enable the linking of ETSs where the ambition of the two ETSs differs. Yet Lazarus et al. (2015) demonstrate that depending on how exchange rates are defined, they may lead to both higher or lower total abatement (across linked ETSs). Uncertainties and information asymmetries may lead a regulator to set an exchange rate ex ante that, although seemingly effective, turns out to increase the emissions from the two ETSs (Lazarus et al., 2015).

In contrast, **discount rates** do not lead to a lower total abatement. While discount rates could increase total abatement in situations where ETSs are not over-allocated, they may not effectively address unit quality from an over-allocated ETS. This is illustrated with the following example (Schneider, Füssler, La Hoz Theuer, et al. 2017):

Assume Country A with an economy-wide NDC has an ETS A with a cap of 100 $MtCO_2$, whereas the BAU emissions of the ETS are 90 $MtCO_2$. In this case, there is an over-allocation of 10 $MtCO_2$. The ETS A is linked with ETS B, which is not over-allocated. Following a simplistic approach, one might argue that the "mitigation value" of units from ETS A is 0.9 (90/100) and that the units can thus be transferred to ETS B based on a discount factor of 0.9. Assume now that 5 million units from ETS A would be transferred to ETS B and used for compliance with the cap of ETS B. Due to the over-allocation of 10 million units in ETS A, the regulated entities in ETS A could transfer 5 million units without pursuing any mitigation action. Hence, emissions in ETS A could remain unaffected. In ETS B, the regulated entities receive 4.5 million allowances (90% × 5) and can increase their emissions by that amount. Overall, the transfer leads to an increase in total emissions by 4.5 $MtCO_2$ compared to a situation without transfer. When transferring units without discounting, total emissions would increase by 5 $MtCO_2$. In this example, discounting mitigated the impact of transferring units from the over-allocated ETS only marginally, by the rate of discounting, i.e. by 10%.

The effectiveness of a discount rate thus not only depends on the amount of over-allocation but also on the number of units actually transferred. Transferred units only start to represent real mitigation action once the transferred amount exceeds the over-allocation in the overallocated ETS. Therefore, discounting can only address over-allocation if the amount of transferred units is larger than the over-allocation or hot air in the transferring system and if the discount rate is set sufficiently low. The discount rate, moreover, would have to be set ex ante by estimating the amount of units that will be transferred. This, in turn, faces the same difficulties as described above for setting the exchange rate level.

8 ENVIRONMENTAL INTEGRITY RISKS FROM CARRY-OVER

While the focus of this study lies primarily on addressing environmental integrity risks from international transfers, in this section we briefly discuss environmental integrity risks in the context of a possible carry-over under the Paris Agreement. We focus on a possible carry-over within the Agreement but do not discuss a possible carry-over of Kyoto units into the Agreement, as the potential to undermine environmental integrity would be significant if this were allowed.

Carry-over (also referred to as "banking") means that a country's (or an entity's) overachievement of its target in one period can be used towards achievement of the target of a subsequent period. Carry-over provisions exist in both domestic and international carbon market regimes, such as under ETSs and under the Kyoto Protocol. The Paris Agreement, however, does not include any provisions for carry-over.

Carry-over provisions provide flexibility on the timing of emission reductions. Allowing carry-over could provide incentives to take early abatement action and help manage abatement costs across periods. This, in turn, could facilitate the achievement of subsequent targets at lower cost which could, in theory, facilitate the adoption of more ambitious mitigation targets. Carry-over is particularly relevant in the context of ETSs: PMR and ICAP (2016), for example, argue that temporal flexibility is key to managing costs and price volatility in ETSs.

In the context of the Paris Agreement, carry-over provisions could aim to align carry-over under ETSs with the achievement of NDC targets. Most ETSs allow entities to carry-over allowances between compliance periods. The possibility to carry-over allowances enables entities to overachieve an ETS target in one compliance period and to under-achieve the ETS target in a subsequent compliance period. This could impact the country's ability to achieve its NDC targets: if carry-over is extensively used in its ETS, the country may overachieve its NDC target in a current period, but may risk not achieving its NDC target for a subsequent period. This issue could be addressed by allowing for carry-over at NDC level, such that the carry-over of allowances in the ETS could be accounted for when achieving NDC targets. Another approach could be setting a future NDC target at a level that takes into account the carry-over of allowances under the ETS.

Yet much like in the case of international transfers, carry-over provisions can undermine environmental integrity and lead to higher cumulative emissions. If a country with an NDC target less stringent than BAU in one period transfers its hot air to a subsequent period, cumulative GHG emissions would be higher than if the same targets were achieved without carry-over. Carry-over of hot air could thus entrench low mitigation ambition over time. Despite the considerable uncertainty surrounding BAU emission estimates and the exact amount of hot air, the available independent analysis of NDC targets show that the potential amount of hot air is very significant. Our evaluation of two assessments of NDC targets suggests that up to half of the current NDC targets could include hot air and that the amount of hot air could amount to several $GtCO_2e$ in 2030 (Section 3.4). The environmental integrity risks from carry-over of hot air are thus material and could trigger difficulties quite similar to those faced under the Kyoto Protocol.

In this context, an important consideration is whether and how the possibility to carry-over influences the ambition of mitigation targets. In theory, the possibility for carry-over could enable countries to set future mitigation targets at more ambitious levels, as it may be easier to achieve them. On the other hand, provisions that allow for the carry-over could also generate a perverse incentive for countries to set NDC targets unambitiously, in order to carry-over larger amounts to the future. In practice, there seems to be little evidence that countries take carry-over into account when setting mitigation targets. In many countries, setting the level of mitigation targets is a process that takes place at the highest political level. Carry-over provisions are usually not a determinant factor; instead, target setting often revolves primarily around political compromises.

A further important consideration are the long-term consequences. Explicit carry-over provisions under the Paris Agreement could create a "right" that, once established, countries may not wish to forego. Some countries may never have intended to make use of carry-over; however, once provisions for carry-over are in place, it could become politically more challenging not to make use of this "right". For these reasons, it might also be very challenging to amend or abandon carry-over rules once they have been established. This was the case under the Kyoto Protocol, where attempts to amend carry-over provisions to address hot air under the first commitment period led to vehement opposition (see Section 4.2). Another example is the EU-ETS, where reforms of the ETS for the next trading period are currently being debated. Despite the fact that a large surplus of allowances has plagued the ETS for many years, proposals to cancel a significant portion of the surplus have faced strong opposition. Estimates by the European Environment Agency (2016) indicate that the system will remain oversupplied for at least another decade.

8.1 Carry-over under the Paris Agreement

The Paris Agreement does not have any explicit rules for carry-over; it neither allows nor disallows it. Few Parties have so far referred to carry-over in their submissions. In submissions to the Ad Hoc Working Group on the Paris Agreement, Switzerland[18] and The Independent Association of Latin America and the Caribbean (AILAC)[19] mention that guidance on carry-over should be discussed. Brazil[20] states that carry-over should only be allowed for CDM or "sustainable development mechanism CERs" "up to a maximum for each unit type of 2.5 per cent of the subsequent quantified amount, if requested by the Party concerned". The Alliance of Small Island States (AOSIS)[21] mentioned that under the Kyoto Protocol, carry-over rules "enabled a build-up of surplus units".

Some Parties seem to be of the view that carry-over is possible, even if no international rules are elaborated, because the self-determined nature of NDCs could be interpreted to allow countries to define not only the mitigation target but also the accounting provisions to achieve it. Other Parties seem to hold the view that carry-over is not possible, unless rules are put in place, which could follow from the principle that accounting for NDCs under the Paris Agreement should be in accordance with international guidance (Article 4.13).

The question of whether carry-over is *technically* possible under the Paris Agreement is closely linked to how NDC targets are expressed and accounted for. Carry-over has so far only been implemented in systems that have quantified, multi-year GHG targets and issue units or allowances corresponding to an emissions budget. The many challenges in the expression and quantification of NDC targets, as discussed in Section 3.1, are thus also relevant here. Theoretically, it would also be possible to implement carry-over between single-year targets, for example by using the overachievement from a single-year 2025 target towards achievement of a single-year 2030 target. This, however, might increase perverse incentives for countries to generate more surplus in target years by engaging in one-off measures that reduce emissions only in the target year, as compared to engaging in mitigation actions that reduce the country's cumulative emissions pathway.

18 http://www4.unfccc.int/Submissions/Lists/OSPSubmissionUpload/591_321_131354245868516139-Swiss_submission_on_mitigation_(APA_item_3).pdf

19 http://www4.unfccc.int/Submissions/Lists/OSPSubmissionUpload/233_318_131354732820248158-170331%20AILAC%20Submission%20Article%206%202017.pdf

20 http://www4.unfccc.int/Submissions/Lists/OSPSubmissionUpload/525_317_131354419477778493-BRAZIL%20-%20Article%206.2.%20SBSTA46%20May%202017.%20FINAL.pdf

21 http://www4.unfccc.int/Submissions/Lists/OSPSubmissionUpload/167_317_131382181838031501-AOSIS_Submission_Art%206%202%20and%206%204%20of%20%20PA.27.04.2017.FINAL.pdf

8.2 Limiting carry-over

Much like in the case of limits for international transfers, countries could establish limits on carry-over and establish them in various ways. Many of the design features explored in Section 5 are relevant. In particular:

1. **Relative versus absolute limits**: Carry-over limits could be *relative*, in that they would allow countries to engage in carry-over to the extent that they reduce emissions below a certain limit. Carry-over limits could also be *absolute*, in that they would generally limit the *volume* of carry-over, or its use.

2. **Point of application**: Carry-over limits could be applied to the carry-over itself – i.e. limiting the amount that can be carried over – or limits could be put on the use of such carry-over. The carry-over provisions of the Doha Amendment to the Kyoto Protocol, for example, place no restrictions on the act of carry-over, but limits how carried-over units can be *used*. As described in Section 4.2.1, the Doha rules determine that carried-over units from the first commitment period can be used domestically in the second commitment period only if the country's second commitment emissions are higher than its target. International transfers of carried-over units are possible, yet only across specific accounts and subject to an absolute limit of 2% of the assigned amount of the using country in the first commitment period.

3. **Methods for determining limits**:
   - *Relative limits* on carry-over could be designed much like relative limits on international transfers, as described in Section 6.1.5. A limit based on average historical GHG emissions would resemble the provisions of Article 3.7ter of the Doha Amendment to the Kyoto Protocol, although it would apply only to carry-over across contribution periods. The challenges with relative limits identified in Section 6 would also apply here, in particular finding an appropriate method that prevents the carry-over of hot air while enabling the carry-over of overachievement that results from mitigation action.
   - *Absolute limits* on carry-over under the Paris Agreement could, for example, include a limit whereby countries can carry over a fixed percentage of a certain indicator, e.g. X% of the quantified NDC trajectory of the previous period or Y% of the country's reported emissions. This option is analogous to Kyoto Protocol limits, where the carry-over of unused CERs and ERUs is limited to 2.5% of the assigned amount of the first commitment period of that Party. Alternatively, or in addition, the use of carry-over could be (partially) limited to domestic use only.

Limits on carry-over would likely face similar challenges as limits on international transfers. For relative limits, it may be difficult to find and agree on a suitable method to establish the limit. Absolute limits do not differentiate between countries with NDC targets that are more stringent or less stringent than BAU and would thus be bluntly applicable to all countries. To effectively prevent the transfer of hot air, they would have to be set rather stringently. Such limitation could, in turn, have impacts on the alignment between ETSs and NDCs as outlined above. A possible measure to mitigate this latter concern could be allowing carry-over only in the context of ETSs. This approach may, however, come at the cost of safeguarding environmental integrity in the case of ETSs that are significantly oversupplied due to the ETS target being less stringent than BAU. If a surplus from over-allocation was carried over under the ETS and also carried over at the NDC level, then environmental integrity could be compromised.[22] If on the other hand, a country was not able to carry-over under the Paris Agreement, it may have to either engage in more mitigation action or purchase ITMOs from another country in order to achieve its subsequent NDC target

22 This would not hold if the NDC is target is sufficiently below BAU so that the country would not be able to carry-over at NDC level or could only carry-over if it reduces further emissions in non-ETS sectors.

(assuming that the NDC is the same as when carry-over would be possible). Box 5 illustrates an important example from the Kyoto Protocol: the discussions around limits on international carry-over under the Doha Amendment and on carry-over under the EU ETS.

Box 5: International limits on carry-over in the context of ETSs: The EU ETS and the Doha Amendment

Decision 1/CMP.8 adopting the Doha Amendment sets limits on the international carry-over of AAUs from the first to the second commitment period of the Kyoto Protocol (see Section 4.2.1). In the negotiations on this provision, a key controversy was whether this provision is applied to individual EU member states or to the EU as a whole. The application of these rules to the EU as a whole – and not to each EU country separately – was essential for the EU in order to ensure that the carry-over of ETS allowances could be shadowed by a corresponding carry-over of AAUs.

The application at the EU level could, however, have considerable consequences for the EU's mitigation over time. The application to the EU as a whole implies that about 2.7 billion more AAUs are available in the second commitment period compared to the amount of AAUs if the Doha rules had been applied to individual member states (Kollmuss 2013). At the same time, the EU ETS was considerably over-supplied by the end of 2012. The carry-over under the EU ETS, and the shadowed carry-over under the Kyoto Protocol, may thus imply that the EU has to pursue less mitigation action than if these rules would have been applied to EU member states individually. The exact effect hinges on several assumptions.

This case illustrates that that any limits on carry-over can be politically and technically complex. Moreover, when accounting for international mitigation targets, whether and how carry-over from ETS is shadowed can have considerable implications on the cumulative mitigation action over time.

Overall, given the considerable amount of potential hot air in current NDC targets, carry-over provisions under the Paris Agreement could pose serious risks for the cumulative mitigation action by countries. While limits on carry-over could reduce the risk, they could be both politically and technically challenging to implement. Parties could thus also consider not introducing any provisions for carry-over.

9 CONCLUSIONS

Countries are currently negotiating the rules for international transfers under Article 6 of the Paris Agreement. An important – and controversial – issue in the negotiations is whether and how international rules should promote environmental integrity. This study assesses some of the key risks to environmental integrity and discusses possible international rules to mitigate these risks, with a particular focus on options for limiting international transfers.

Environmental integrity risks in the context of current NDC targets

An important risk for environmental integrity is the diverse ambition of current NDC targets. While some countries have ambitious mitigation targets, some may not need to take any mitigation action to achieve their NDC targets. Many NDC targets could be less stringent than the likely level of BAU emissions, and thus contain hot air. If this hot air is transferred to other countries – or carried-over and used to achieve future NDC targets – cumulative aggregated GHG emissions would increase, compared to a situation in which the same targets are achieved without transfers.

Our analysis shows that at a global level there could be a significant amount of hot air under a broad range of scenarios and assumptions, similar in magnitude as the mitigation pledged by countries with NDC targets more stringent than BAU. Thus, while the results are uncertain for specific countries, they suggest that the overall risk of hot air is material.

Addressing environmental integrity risks

Addressing the risk of transfer or carry-over of hot air is important for two reasons. First, international transfer or carry-over of hot air could increase global GHG emissions under current NDC targets – and thereby *directly* undermine environmental integrity. And second, not preventing the transfer of hot air could provide incentives for transferring countries to set future mitigation targets at less ambitious levels, in order to accrue more economic benefits from international transfers – and thereby *indirectly* undermine environmental integrity.

This study identifies three broad approaches that could mitigate these risks: limiting international transfers; ensuring that international transfers are backed by units that have quality; and ensuring that countries adopt ambitious NDC targets. The latter option, although theoretically possible, would be both technically and politically very challenging and is therefore not explored in this study.

Limits on international transfers

Limits on international transfers could be pursued to achieve three policy objectives: avoiding the transfer of hot air, reducing the incentives for transferring countries to set future NDC targets at less ambitious levels, and preventing "over-selling" of ITMOs. At the same time, establishing limits should enable countries to engage in transfers of ITMOs that result from mitigation actions.

If the main objective of limits is preventing the transfer of hot air while enabling the transfers of emission reductions from mitigation actions, **relative limits** based on BAU emissions projections would – theoretically – be the best approach. Such limits would allow countries with targets more stringent than BAU to transfer ITMOs unhindered, while still preventing international transfers of hot air. Yet the practical implementation of this approach is hampered by the many uncertainties in estimating BAU emissions projections, and by the difficulties in reaching international agreement on assessing BAU emissions of countries.

To avoid the determination of BAU emissions projections, countries could pursue alternative approaches for establishing relative limits. The road-testing of these alternatives, however, showed that finding reliable approaches is difficult: historical circumstances are often not representative of future developments, and trends often change over time. While some approaches effectively avoid the transfer of hot air for some countries, they do not work for the circumstances of other countries. None of the tested approaches reliably prevented the transfer of hot air for all tested countries while allowing the transfer of ITMOs that result from mitigation action. It was also not possible to identify groups of countries, such as developed or developing countries, for which a particular approach would consistently achieve these objectives.

Among the approaches tested for relative limits, limits based on average historical emissions – as proposed by Brazil – could be an interesting approach to consider further. This approach would imply that countries can only transfer ITMOs if they are on a decreasing emissions pathway. That would prevent the transfer of nearly all hot air contained in current NDC targets: it would curtail all hot air from any country with increasing emissions, and only a few of the countries with decreasing emissions are estimated to have hot air. Such a limit could, moreover, provide incentives for countries to engage in a decreasing emissions pathway and might promote the adoption of more ambitious mitigation targets. It could also be argued that the approach is consistent with the long-term goals of the Paris Agreement, which require global emissions to peak within the next decade. Once countries are on decreasing emissions pathways, however, the approach may not be effective in preventing the transfer of hot air. Moreover, if the limits are set based on the actual emissions in the previous contribution period, they might provide some disincentives for countries to over-achieve their NDC targets, as this would imply stricter limits in the subsequent contribution period.

An important challenge of this approach is that most countries still have increasing emissions trends. Many countries would need to take significant additional mitigation action beyond their NDCs before they could engage in international transfers of ITMOs. To address this challenge, such a limit could only be applied to some types of transfers. Brazil, for example, proposes to apply this type of limit only to transfers under Article 6.2 and to allow countries to engage in international transfers under Article 6.4 without any limitation.

Absolute limits could be another alternative, as they are simple to implement and provide ex ante certainty on how many ITMOs can be transferred over a certain period of time. They are, however, bluntly applicable to all countries, irrespective of the environmental integrity risk that the transfer poses. Such limits would thus *contain*, rather than *address*, the risk of transferring hot air. To be effective in preventing the transfer of hot air, absolute limits would have to be set at low levels. The road-testing of absolute limits indicates, for example, that a 1% limit would prevent about 90% of the hot air from being transferred. Stringent absolute limits could, however, also limit the ability of countries to engage in international transfers. This could raise, in particular, concerns when the amount of transfers is not controlled by governments but driven by private sector entities, such as in the international linking of ETSs.

For both relative and absolute limits, options could be considered to apply limits only to some types of transfers. While this increases complexity, it may help to promote environmental integrity – by limiting those types of transfers that may involve higher environmental integrity risks – while at the same time enabling countries to engage in international transfers that result from mitigation action.

Ensuring unit quality in international transfers

If international transfers are backed by mechanisms that ensure unit quality, environmental integrity can be ensured even if NDCs contain hot air.

This study identifies several ways of how international rules could facilitate unit quality. First, countries could be required to report on how they ensure environmental integrity and the reported information could be internationally reviewed. Second, international guidance could further define and clarify the term "environmental integrity" and elaborate how mechanisms should be designed and implemented to ensure it. And third, mechanisms could be required to undergo an international approval process before they can be used under Article 6 – similar to the approval of programs under CORSIA. The effectiveness of these approaches is uncertain and would depend crucially on (a) the robustness and specificity of any international guidance or criteria; (b) the ability of the international assessment or review process to identify any issues; and (c) the willingness of Parties to implement corrective measures in response to identified issues.

Given the political challenges to establish robust international rules, countries could, in parallel, also pursue avenues outside the UNFCCC to promote unit quality. These could include political declarations, green investment schemes, carbon clubs, and discount or exchange rates. The ability of these approaches to ensure unit quality seems also uncertain. Their effectiveness hinges strongly on the willingness and ability of countries to identify and engage in mechanisms that ensure unit quality, irrespective of changing political landscapes or increasing costs of mitigation.

Risks from carry-over of hot air

The Paris Agreement does not include any provisions for the carry-over of overachievement of NDC targets to subsequent periods, but some Parties have proposed such provisions. Allowing for carry-over could provide flexibility on the timing of emission reductions and align the carry-over under ETSs with the accounting of NDC targets. It could, however, also pose serious environmental integrity risks – as carry-over of hot air to subsequent periods could lead to higher cumulative GHG emissions and entrench low mitigation ambition over time. Limits could potentially reduce the risk but could be both politically and technically challenging to implement. Given the considerable potential of hot air in current NDC targets, Parties could thus also consider not introducing any provisions for carry-over.

Recommendations

International carbon markets can only achieve their objectives if they ensure environmental integrity. If environmental integrity is not ensured, they neither reduce emissions nor reduce the costs of mitigating climate change.

The risks to environmental integrity identified in this study are considerable. Current NDC targets appear to contain a significant volume of hot air. If international rules enable an unhindered transfer of hot air and countries engage in such transfers, aggregated GHG emissions could increase beyond the pledges in current NDCs. Moreover, countries could have incentives to set future mitigation targets at less ambitious levels. While ensuring unit quality could address these concerns, the experience from the Kyoto Protocol and existing carbon market mechanisms suggests that ensuring unit quality can be both technically and politically challenging.

Given these risks, identifying effective means to ensure environmental integrity is critical. Without international rules to promote environmental integrity, it is uncertain whether Parties will be able address these risks on their own. We therefore recommend that Parties consider the following environmental integrity provisions in rules under the Paris Agreement:

- **Relative limits** based on historical GHG emissions, such as those contained in proposals by Brazil. These could prevent the transfer of nearly all hot air contained in current NDC targets. Such limits, however, would only allow countries to transfer ITMOs if they are on a decreasing emissions pathway.

- **Absolute limits** set at sufficiently low levels to prevent any individual country from transferring large amounts of hot air. They are simple to implement and provide ex ante certainty on the volume of permissible transfers, but they are bluntly applicable to all countries. They would thus contain, rather than address, the risk of transferring hot air.

- **International guidance, reporting, and review on mechanism design and implementation**, to help enhance the quality of units transferred internationally. Such guidance could also help prevent any potentially less robust mechanisms under Article 6.2 from "outcompeting" a more robust (and therefore more costly) mechanism under Article 6.4. The effectiveness of this approach hinges strongly on the specificity of the guidance and countries' adherence to it.

- **Eligibility criteria** applied to prospective mechanisms under Article 6.2, to enhance the quality of units transferred internationally. However, success would depend on the specificity of these criteria and on their consistent implementation.

The last two approaches also do not address situations in which countries transfer ITMOs without engaging in any mechanism.

It is important to stress that the effectiveness of these measures depends on *how* they are implemented. A loose limit on international transfers may have no impact on environmental integrity. Similarly, vague eligibility criteria or international guidance on unit quality and weak governance arrangements to ensure adherence may not affect the type and scale of transfers countries engage in. Whether an approach is effective may thus largely depend on the political feasibility to design it in a meaningful manner. Moreover, since it may be difficult to amend or introduce new rules once the Paris rulebook is in place, it is essential that Parties move swiftly to address the significant environmental integrity risks from hot air.

10 REFERENCES

Aldrich, E. L. and Koerner, C. L. (2012). Unveiling assigned amount unit (AAU) trades: Current market impacts and prospects for the future. *Atmosphere*, 3(1). 229–45. DOI:10.3390/atmos3010229.

Boehringer, C. (2000). Cooling down hot air: A global CGE analysis of post-Kyoto carbon abatement strategies. *Energy Policy*, 28(11). 779–89. DOI:10.1016/S0301-4215(00)00060-4.

Boehringer, C. and Loeschel, A. (2003). Market power and hot air in international emissions trading: the impacts of US withdrawal from the Kyoto Protocol. *Applied Economics*, 35(November). 651–63. DOI:10.1080/0003684021000035818.

Boehringer, C., Moslener, U. and Sturm, B. (2007). Hot air for sale: a quantitative assessment of Russia's near-term climate policy options. *Environmental and Resource Economics*, 38(4). 545–72. DOI:10.1007/s10640-007-9089-4.

Brandt, U. S. and Svendsen, G. T. (2004). Surplus emission allowances as implicit side payments: could 'Hot Air' have saved the Kyoto Agreement? *Climate Policy*, 4(3). 303–18. DOI:10.1080/14693062.2004.9685527.

CAIT Climate Data Explorer (2016). INDC Dashboard. http://cait.wri.org/indc/.

Cames, M., Harthan, R. O., Füssler, J., Lazarus, M., Lee, C. M., Erickson, P. and Spalding-Fecher, R. (2016). *How Additional Is the Clean Development Mechanism?* Öko-Institut. https://ec.europa.eu/clima/sites/clima/files/ets/docs/clean_dev_mechanism_en.pdf

Carbone, J. C., Helm, C. and Rutherford, T. F. (2009). The case for international emission trade in the absence of cooperative climate policy. *Journal of Environmental Economics and Management*, 58(3). 266–80. DOI:10.1016/j.jeem.2009.01.001.

Climate Action Tracker (2015). Tracking (I)NDCs: Assessment of mitigation contributions to the Paris Agreement (2015). http://climateactiontracker.org/countries.html.

Climate Action Tracker (2017). Tracking (I)NDCs: Assessment of mitigation contributions to the Paris Agreement (2017). http://climateactiontracker.org/countries.html.

Dechezlepetre, A., Calel, R., Colmer, J., Gennaioli, C., Glachant, M. and Schröeder, A. (2014). *Assessing the Additionality of the Clean Development Mechanism: Quasi Experimental Evidence from India*.

den Elzen, M. G. J. and de Moor, A. P. G. (2002). Analyzing the Kyoto Protocol under the Marrakesh Accords: economic efficiency and environmental effectiveness. *Ecological Economics*, 43(2–3). 141–58. DOI: 10.1016/S0921-8009(02)00181-7.

den Elzen, M., Roelfsema, M. and Slingerland, S. (2010). Dealing with surplus emissions in the climate negotiations after Copenhagen: What are the options for compromise? *Energy Policy*, 38(11). 6615–28. DOI:10.1016/j.enpol.2010.06.032.

Erickson, P., Lazarus, M. and Spalding-Fecher, R. (2014). Net climate change mitigation of the Clean Development Mechanism. *Energy Policy*, 72. 146–54. DOI: 10.1016/j.enpol.2014.04.038.

European Environment Agency (2016). *Trends and Projections in the EU ETS in 2016: The EU Emissions Trading System in Numbers*. DOI:10.2800/472636.

Falkner, R. (2015). A minilateral solution for global climate change? On bargaining efficiency, club benefits and international legitimacy. Working Paper No. 222. http://www.lse.ac.uk/GranthamInstitute/wp-content/uploads/2015/07/Working-Paper-197-Falkner.pdf

Graichen, J., Cames, M. and Schneider, L. (2016). *Categorization of INDCs in the Light of Art. 6 of the Paris Agreement.* Umweltbundesamt. https://www.dehst.de/SharedDocs/downloads/EN/project-mechanisms/Categorization_of_INDCs_Paris_agreement_discussion_paper.pdf;jsessionid=BFBA59FBBE7934C1FBD81AF1ABD7C9D6.1_cid284?__blob=publicationFile&v=2

Grubb, M. (2016). Full legal compliance with the Kyoto Protocol's first commitment period – some lessons. *Climate Policy*, 3062(June). 1–8. DOI:10.1080/14693062.2016.1194005.

Grubb, M., Laing, T., Counsell, T. and Willan, C. (2011). Global carbon mechanisms: lessons and implications. *Climatic Change*, 104(3). 539–73. DOI:10.1007/s10584-009-9791-z.

Haya, B. and Parekh, P. (2011). *Hydropower in the CDM: Examining Additionality and Criteria for Sustainability*. Berkeley Energy and Resources Group. Retrieved from http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2120862.

He, G. and Morse, R. (2013). Addressing carbon Offsetters' Paradox: Lessons from Chinese wind CDM. *Energy Policy*, 63. 1051–1055. DOI: 10.1016/j.enpol.2013.09.021

Helm, C. (2003). International emissions trading with endogenous allowance choices. *Journal of Public Economics*, 87(12). 2737–47. DOI:10.1016/S0047-2727(02)00138-X.

Holtsmark, B. and Sommervoll, D. E. (2012). International emissions trading: Good or bad? *Economics Letters*, 117(1). 362–64. DOI: 10.1016/j.econlet.2012.05.034.

Howard, A., Chagas, T., Hoogzaad, J. and Hoch, S. (2017). *Features and Implications of NDCs for Carbon Markets*. Climate Focus. http://www.energimyndigheten.se/contentassets/2600659ecfa54ec995b835a4c99d75fb/final_report_ndcs_and_art._6.2-002.pdf.

ICAO (2016). *Assembly - 39th Session: Report of the Executive Committee on Agenda Item 22 (Global Market-Based Measure Scheme)*. Doc Nr. A39-WP/530. International Civil Aviation Organization (ICAO). http://www.icao.int/Meetings/a39/Documents/WP/wp_530_en.pdf

IEA (2015). *World Energy Outlook*. International Energy Agency (IEA). https://www.iea.org/publications/freepublications/publication/WEO2015.pdf.

IEA (2016). *World Energy Outlook 2016*. International Energy Agency (IEA).

IETA (2015). *Making Waves: GHG Market 2015/16*. International Emissions Trading Association (IETA). http://www.ieta.org/resources/Resources/GHG_Report/2015/IETA_GHG_Report_2015_web.pdf.

IISD (2012). Summary of the Doha Climate Change Conference: 26 November – 8 December 2012. *Earth Negotiations Bulletin*, 12(567). http://www.iisd.ca/climate/cop18/enb/.

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*. O. Edenhofer, R. Pichs-Madruga, Y. Sokona, E. Farahani, S. Kadner, et al. (eds.). Cambridge University Press.

Klepper, G. and Peterson, S. (2005). Trading hot-air. The influence of permit allocation rules, market power and the US withdrawal from the Kyoto Protocol. *Environmental & Resource Economics*, 32(2). 205–27. DOI: 10.1007/s10640-005-3362-1.

Kollmuss, A. (2013). *Doha Decisions on the Kyoto Surplus Explained*. Carbon Market Watch. http://carbonmarketwatch.org/wp-content/uploads/2013/03/CarbonMarketWatch-CO18-Surplus_decisions_explained_4March20131.pdf.

Kollmuss, A., Schneider, L. and Zhezherin, V. (2015). *Has Joint Implementation Reduced GHG Emissions? Lessons Learned for the Design of Carbon Market Mechanisms*. Working paper, 2015-07. Stockholm Environment Institute (SEI). http://www.sei-international.org/publications?pid=2803.

Kreibich, N. and Hermwille, L. (2016). *Robust Transfers of Mitigation Outcomes: Understanding Environmental Integrity Challenges*. JIKO Policy paper, 02/2016. Wuppertal Institute. http://www.carbon-mechanisms.de/fileadmin/media/dokumente/publikationen/PP_2016_02_Robust_Transfers_bf.pdf.

Lazarus, M., Kollmuss, A. and Schneider, L. (2014). *Single-Year Mitigation Targets: Uncharted Territory for Emissions Trading and Unit Transfers*. Working Paper, 2014-01. Stockholm. https://www.sei-international.org/publications?pid=2487.

MacKenzie, I. A. (2011). Tradable permit allocations and sequential choice. *Resource and Energy Economics*, 33(1). 268–78. DOI: 10.1016/j.reseneeco.2010.06.004.

Marcu, A. (2017). *Views on Mitigation Value and Its Application*. International Centre for Trade and Sustainable Development (ICTSD). http://www.ictsd.org/sites/default/files/research/ercst-ictsd_mitigation_value_0.pdf.

Meinshausen, M., & Alexander, R. (2016). *NDC & INDC Factsheets*. Australian-German Climate and Energy College. http://www.climate-energy-college.net/indc-factsheets

Michaelowa, A., Greiner, S., Hoch, S., LE Saché, F., Brescia, D., Galt, H., Mayr, S. and Diagne, E.-H. M. (2015). *The Paris Agreement: The Future Relevance of UNFCCC-Backed Carbon Markets for Africa*. http://www.climatefocus.com/publications/paris-agreement-future-relevance-unfccc-backed-carbon-markets-africa.

Michaelowa, A. and Purohit, P. (2007). *Additionality Determination of Indian CDM Projects*. http://climatestrategies.org/wp-content/uploads/2007/02/additionality-cdm-india-cs-version9-07.pdf.

Morel, R. (2013). *How the Negotiators Tackled the "Hot Air" Issue for the Second Commitment Period of the Kyoto Protocol*. Analysis, February 2013. http://www.cdcclimat.com/IMG//pdf/13-02-12_analysis_-_ukraine-3.pdf.

Obergassel, W. and Gornik, M. (2015). Update on the Role of Market Mechanisms in Intended Nationally Determined Contributions. *JIKO Policy Brief*, (04/2015). http://www.carbon-mechanisms.de/en/2015/update-on-role-of-market-mechanisms-in-intended-nationally-determined-contributions/,

OECD (2017). *Impacts of the Fukushima Daiichi Accident on Nuclear Development Policies*. Organisation for Economic Co-operation and Development (OECD). http://www.oecd-nea.org/ndd/pubs/2017/7212-impacts-fukushima-policies.pdf.

Paltsev, S. V. (2000). *The Kyoto Protocol: 'Hot Air' for Russia?* Working Paper, 00-9. http://www.colorado.edu/economics/papers/papers00/wp00-9.pdf.

PMR (2015). *Checklist on Establishing Post-2020 Emission Pathways*. Partnership for Market Readiness (PMR). https://openknowledge.worldbank.org/bitstream/handle/10986/21877/EPEP_eBook.pdf.

PMR and ICAP (2016). *Emissions Trading in Practice: A Handbook on Design and Implementation*. Partnership for Market Readiness (PMR), International Carbon Action Partnership (ICAP). https://openknowledge.worldbank.org/handle/10986/23874.

Point Carbon (2012). *Carry-over of AAUs from CP1 to CP2 - Future Implications for the Climate Regime.* http://carbonmarketwatch.org/wp-content/uploads/2012/11/AAU-banking-briefing-paper-Point-Carbon.pdf.

Prag, A., Hood, C. and Barata Martins, P. (2013). *Made to Measure: Options for Emissions Accounting under the UNFCCC*. OECD/IEA Climate Change Expert Group Papers, 2013/01. OECD Publishing, Paris. DOI: 10.1787/5jzbb2tp8ptg-en.

Purdon, M. (2014). *Ex-Post Evaluation of the Additionality of a Clean Development Mechanism Cogeneration Project in Uganda: The Significance of Changes in Project Financing and Background Economic Conditions*. Working Paper No. 152. http://www.lse.ac.uk/GranthamInstitute/wp-content/uploads/2014/04/Working-Paper-152-Purdon-2014.pdf.

Ranson, M. and Stavins, R. N. (2016). Linkage of Greenhouse Gas Emissions Trading Systems: Learning from Experience. *Climate Policy*, 16(3). DOI:10.1080/14693062.2014.997658.

Rehdanz, K. and Tol, R. S. J. (2005). Unilateral regulation of bilateral trade in greenhouse gas emission permits. *Ecological Economics*, 54(4). 397–416. DOI:10.1016/j.ecolecon.2004.08.009.

Rogelj, J., Elzen, M. Den, Fransen, T., Fekete, H., Winkler, H., Schaeffer, R., Sha, F., Riahi, K. and Meinshausen, M. (2016). Paris Agreement climate proposals need boost to keep warming well below 2°C. *Nature Climate Change*, 534. 631–639. DOI:10.1038/nature18307.

Schneider, L. (2009). Assessing the additionality of CDM projects: practical experiences and lessons learned. *Climate Policy*, 9(3). 242–54. DOI:10.3763/cpol.2008.0533.

Schneider, L., Füssler, J., Kohli, A., Graichen, J., Healy, S., et al. (2017). *Robust Accounting of International Transfers under Article 6 of the Paris Agreement*. German Emissions Trading Authority (DEHSt). https://www.dehst.de/SharedDocs/downloads/EN/project-mechanisms/Differences_and_commonalities_paris_agreement_discussion_paper_28092017.pdf?__blob=publicationFile&v=3

Schneider, L., Füssler, J., La Hoz Theuer, S., Kohli, A., Graichen, J., Healy, S. and Broekhoff, D. (2017). *Environmental Integrity under Article 6 of the Paris Agreement*. https://www.dehst.de/SharedDocs/downloads/EN/project-mechanisms/Discussion-Paper_Environmental_integrity.pdf?__blob=publicationFile&v=2.

Schneider, L., Lazarus, M., Lee, C. and van Asselt, H. (2017). Restricted linking of emissions trading systems: options, benefits, and challenges. *International Environmental Agreements: Politics, Law and Economics*, . DOI:10.1007/s10784-017-9370-0.

Shishlov, I., Morel, R. and Bellassen, V. (2016). Compliance of the Parties to the Kyoto Protocol in the first commitment period. *Climate Policy*, 0(0). 1–15. DOI:10.1080/14693062.2016.1164658.

Spalding-Fecher, R., Narayan Achanta, A., Erickson, P., Haites, E., Lazarus, M., Pahuja, N., Pandey, N., Seres, S. and Tewari, R. (2012). *Assessing the Impact of the Clean Development Mechanism*. CDM Policy Dialogue. http://www.cdmpolicydialogue.org/research/1030_impact.pdf.

Tuerk, A., Fazekas, D., Schreiber, H., Frieden, D. and Wolf, C. (2013). *Green Investment Schemes: The AAU Market between 2008 and 2012*. Discussion Paper. Climate Strategies. http://climatestrategies.org/wp-content/uploads/2013/03/cs-gis-discussion-paper-formatted-final-rev2a.pdf.

UNFCCC (n.d.). Glossary of climate change acronyms and terms. http://unfccc.int/essential_background/glossary/items/3666.php. [Accessed 2 October, 2017.]

UNFCCC (2005). Modalities, rules and guidelines for emissions trading under Article 17 of the Kyoto Protocol. (UNFCCC decision 11/CMP.1). http://unfccc.int/resource/docs/2005/cmp1/eng/08a02.pdf#page=17.

UNFCCC (2012). Amendment to the Kyoto Protocol pursuant to its Article 3, paragraph 9 (the Doha Amendment). (UNFCCC decision 1/CMP.8). http://unfccc.int/resource/docs/2012/cmp8/eng/13a01.pdf.

UNFCCC (2016). Emission Reduction Units (ERUs) issued. (By Host Party, Track, and Year). As of 12.00 CET on 1 January 2016. http://ji.unfccc.int/statistics/2015/ERU_Issuance_2015_10_15_1200.pdf.

USDA-ERS (2017). *Projected Real Gross Domestic Product (GDP) and Growth Rates of GDP for Baseline Countries/Regions (in Billions of 2010 Dollars) 2010-2030*. United States Department of Agriculture - Economic Research Service (USDA-ERS). https://www.ers.usda.gov/data-products/international-macroeconomic-data-set.aspx,

van Asselt, H. (2016). *Putting the 'Enhanced Transparency Framework' into Action: Priorities for a Key Pillar of the Paris Agreement*. SEI Policy Brief. Stockholm Environment Institute (SEI). https://www.sei-international.org/mediamanager/documents/Publications/Climate/SEI-PB-2016-Transparency-under-Paris-Agreement.pdf.

Victor, D., Nakicenovic, N. and Victor, N. (1998). *The Kyoto Protocol Carbon Bubble : Implications for Russia, Ukraine and Emission Trading. IIASA Interim Report*. International Institute for Applied Systems Analysis (IIASA). http://pure.iiasa.ac.at/5558/1/IR-98-094.pdf.

Vieweg, M., Schaeffer, M., Chen, C., Gütschow, J., Hare, B. and Rocha, M. (2012). *Hot Topic: AAU Surplus*. Climate Analytics. http://climateanalytics.org/files/hot_topic_aau_surplus_2012.pdf.

Woerdman, E. (2005). Hot air trading under the Kyoto Protocol: An environmental problem or not? *European Environmental Law Review*, 14(3). 71–77. http://www.rug.nl/research/portal/files/17591854/HotAirTrading_EELR.PDF.

World Bank (2013). *Mapping Carbon Pricing Initiatives: Developments and Prospects 2013*. https://openknowledge.worldbank.com/handle/10986/15771.

WRI (2017). *CAIT Climate Data Explorer - Historical Emissions Data*. World Resources Institute (WRI). http://www.wri.org/resources/data-sets/cait-historical-emissions-data-countries-us-states-unfccc.

Yamin, F. and Depledge, J. (2004). *The International Climate Change Regime*. Cambridge University Press.

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