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Averaging or multi-year accounting? Environmental integrity implications for using international carbon markets in the context of single-year targets

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ABSTRACT

Under the Paris Agreement, most countries have communicated Nationally Determined Contributions (NDCs) with mitigation targets for a single year. Single-year targets present considerable challenges when countries use international carbon markets to achieve their NDCs. This paper assesses the environmental integrity implications of the two options that countries with single-year targets can use to account for internationally transferred mitigation outcomes (ITMOs) under Article 6 of the Paris Agreement: averaging and multi-year approaches. To assess the implications of these options, the paper considers a variety of scenarios for how two countries might engage with Article 6 and assesses how the choice of the accounting approach may affect aggregated emissions from the two countries. The paper finds that aggregated emissions could increase, decrease or remain unaffected, depending on: which of the two accounting approaches is chosen by the transferring and the acquiring country; whether the generation or use of ITMOs decreases, increases, or keeps constant over time; whether the countries' emissions in the target year are representative for the countries' emissions trend; and what course of action countries take in the case of a possible over- or under-achievement of their NDC targets.

Key policy insights

- While averaging is simple to implement and does not require countries to establish multi-year trajectories or budgets, it can lead to higher or lower aggregated emissions from the cooperating countries, compared to the situation in which the countries achieved their targets without using Article 6.
- By contrast, under multi-year approaches, aggregated emissions do not change, as long as multi-year targets or trajectories are credibly defined.
- As countries have a free choice between averaging and multi-year approaches, they can strategically pick for each NDC implementation period the accounting approach which requires less effort to achieve a given NDC target. In aggregate, this can undermine environmental integrity.
- Accounting for ITMOs is most robust if all countries moved over time towards robustly defined multi-year targets or trajectories. The risk that countries may inflate multi-year trajectories could be addressed through international guidance and review on the establishment of such trajectories.

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1. Introduction

Under the Paris Agreement, most countries have communicated Nationally Determined Contributions (NDCs) with mitigation targets for a single year (e.g. 2030). Such targets are achieved if the reported emissions (or other relevant indicators) do not exceed the target level for the specific target year. However, they do not

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provide clarity on how emissions will develop over the NDC implementation period (e.g. from 2021 to 2030) and thus imply uncertainty about the cumulative emissions implied by the NDC (Howard et al., 2017; Lazarus et al., 2014; Schneider et al., 2017).

Single-year targets present particular challenges when countries engage in international carbon market mechanisms under Article 6 of the Paris Agreement. Article 6 establishes a framework for countries to engage in international carbon markets and use ‘internationally transferred mitigation outcomes’ (ITMOs) to achieve their NDCs. In doing so, countries shall ‘ensure environmental integrity’ and ‘apply robust accounting’.

Robust accounting is particularly important in the context of single-year targets. Without robust accounting rules, there is a risk that the transfer of ITMOs between countries with single-year targets could undermine environmental integrity, i.e. result in aggregated cumulative emissions from both countries being higher than if the transfer had not taken place or if both countries had defined their NDCs as multi-year targets. Emissions could increase in different ways, for example, if a country uses the cumulative mitigation outcomes generated in another country in pre-target years to achieve its single-year target (Greiner et al., 2019; Howard, 2018; Howard et al., 2017; Kreibich & Obergassel, 2016; Lazarus et al., 2014; Lo Re & Vaidyula, 2019; Michaelowa et al., 2020; OECD & IEA, 2017; Prag et al., 2013; Schneider et al., 2017; Schneider et al., 2019).

At COP26 in Glasgow in November 2021, countries adopted international guidance on accounting for ITMOs under Article 6.2 of the Paris Agreement. This guidance allows countries to choose from two options to account for single-year targets (UNFCCC, 2021, Annex, paragraph 7):

1. *Averaging*, whereby the average number of ITMOs transferred or used over the NDC implementation period (e.g. from 2026 to 2030) is counted in the target year (e.g. 2030); or
2. *Multi-year approaches*, whereby the countries define an indicative *multi-year emissions trajectory or budget* over the NDC implementation period and account for ITMOs transferred or used in each year of the NDC implementation period.

Building on the existing research, this paper assesses under which circumstances the use of these two accounting options may lead to higher, lower or constant aggregated emissions, compared to the situation in which the countries achieved a given NDC target without the use of Article 6. The paper provides simplified numerical examples for a range of pathways for how two countries might engage in the use of ITMOs and analyses the implications of all possible combinations of these pathways and the two accounting approaches. While carbon markets have been found to potentially undermine environmental integrity through double counting of emission reductions and the generation of credits which are not backed by actual emission reductions, this paper shows that a lack of robust accounting rules for the transfer of ITMOs under single-year targets can also pose risks to environmental integrity.

The paper is organized as follows: section 2 further describes the two accounting approaches considered under Article 6. Section 3 describes the methodological approach used in this paper. Section 4 analyses the environmental integrity risks under different scenarios, and section 5 draws conclusions and provides recommendations.

2. Single-year accounting approaches considered under Article 6

The Paris Agreement requires countries engaging in Article 6 to avoid double counting. Double counting occurs if the same emission reduction or removal is counted more than once to achieve climate mitigation targets (Schneider et al., 2019). A robust accounting framework is the main vehicle needed to avoid double counting. Article 6.2 addresses double counting through a form of double-entry bookkeeping, referred to as ‘corresponding adjustments’. The country transferring ITMOs makes an addition to its emissions level, and the country acquiring ITMOs makes a subtraction. Both countries prepare an emissions balance in which the country’s target level is compared with its emissions, adjusted for any international transfers of ITMOs (Müller & Michaelowa, 2019; Schneider et al., 2019). In implementing this approach, an important question is how corresponding adjustments should be applied in the context of single-year targets. The Article 6.2 guidance adopted at COP26 includes two approaches for accounting of ITMOs in the context of single-year targets, which are described in the following (UNFCCC, 2021).

2.1. Multi-year approaches

One option is that countries may establish an indicative multi-year emissions trajectory (or several trajectories) or a budget for the NDC implementation period. An emissions trajectory would not change the NDC itself but support the accounting for ITMOs by defining a path according to which emissions will develop to reach the target. Both acquiring and transferring countries would account for their emissions for all years of the NDC implementation period against this trajectory and not only for the single-target year.

Alternatively, countries can calculate a budget of emissions for the entire NDC implementation period. To assess the achievement of NDCs, countries would compare the cumulative emissions with the emissions budget for the NDC implementation period. An emissions budget approach has been implemented for mitigation targets of industrialized countries under the Kyoto Protocol.

Both approaches, defining a multi-year emissions trajectory and defining a multi-year budget, are referred to as ‘multi-year approaches’ in this paper. The two approaches are similar in that they implicitly ‘translate’ a single-year target into a multi-year approach for accounting purposes. The main difference is that emission budgets may be expressed in units, such as the ‘assigned amount units’ under the Kyoto Protocol.

2.2. Averaging

A second option implies that transferring and acquiring countries account only for the single target year, but the number of corresponding adjustments to be applied in the target year is determined on the basis of the average transfer or use of ITMOs over the NDC implementation period. In this way, the transfer and use of ITMOs in years preceding the target year are recognized in accounting. For example, if a country had transferred two ITMOs in 2026, three in 2027, five in 2028, six in 2029 and four in 2030, it would apply a corresponding adjustment of 4 tCO₂ in 2030 (20 ITMOs transferred over the period divided by 5 years).

Prior to the target year, countries need to annually apply ‘indicative corresponding adjustments’ equal to the cumulative amount of ITMOs transferred or used divided by the elapsed years in the NDC implementation period. These indicative adjustments are *reported* in all pre-target years for transparency purposes. Yet only the final average corresponding adjustments calculated for the target year of the NDC are ultimately *accounted* for, by comparing the target level with the adjusted emissions level.

3. Methodological approach

To assess the environmental integrity implications of these two accounting options, this paper introduces a simplified example of two countries engaging in Article 6. In this example, the transferring and the acquiring country both have a single-year target corresponding to emissions of 10 MtCO₂e in 2030. For simplicity of illustration, it is assumed that, without the engagement in ITMOs, both countries would achieve these targets by keeping emissions constant at 10 MtCO₂e over the NDC implementation period from 2026 to 2030. The use of Article 6 enables them to achieve their NDCs at lower costs.

The paper then analyses which combination of accounting approaches leads to an increase, to a decrease, or to no change of aggregated emissions and under which circumstances. The paper identifies four factors that are decisive for the impact on aggregated emissions:

1. Which of the two *accounting approaches* – averaging or multi-year approaches – is chosen by the transferring and the acquiring country;
2. The development of *the engagement in ITMOs over time*, i.e. whether the countries transfer or use an increasing, decreasing or constant amount of ITMOs over the NDC implementation period (‘ITMO engagement trajectory’);
3. To what extent the *emissions level in the target year* is representative for the country’s emissions trend; and
4. What course of action the countries take in the case that the choice of an accounting approach leads to over- or under-achievement of their NDC targets.

To assess the implications of different ITMO engagement trajectories, the paper establishes three scenarios for how countries might engage in ITMOs over the NDC implementation period:

1. *Increasing engagement in ITMOs over the NDC implementation period:* Such a scenario may, for example, apply to countries selling an increasing number of ITMOs over the next decade as they start to develop and implement more mitigation projects over time. For simplicity, in the two-country example, the number of ITMOs acquired or transferred is assumed to increase linearly by 1 MtCO₂e per year over the NDC implementation period, starting with no engagement in ITMOs in 2026 and reaching a level of 4 million ITMOs in 2030.
2. *Constant engagement in ITMOs over the NDC implementation period:* After a country has started to engage in ITMOs, there might be a period of time in which a relatively constant number of ITMOs is transferred or acquired over the years, for example, in the case of a country that has already purchased a significant amount of carbon credits under the Kyoto Protocol and intends to continue to rely on international carbon credits after 2020. For simplicity, in the two-country example, the number of ITMOs acquired or transferred is assumed to remain constant at 2 million ITMOs in each year of the NDC implementation period.
3. *Decreasing engagement in ITMOs over the NDC implementation period:* After a certain period of time, some countries might cease their engagement in ITMOs, for example if policymakers decide to achieve their NDC domestically like the EU after 2020. For simplicity, in the two-country example, the number of ITMOs acquired or transferred is assumed to decrease linearly by 1 million over the NDC implementation period, starting at a level of 4 million ITMOs in 2026 and resulting in no use of ITMOs in 2030.

In practice, multiple reasons will impact the actual development of a country's engagement in ITMOs over time. To what extent such engagement will increase or decrease depends on the potential and costs of domestic mitigation options, the ambition of the current NDC, the planned trajectory towards achieving long-term goals, and political factors, such as whether a country decides to achieve future targets domestically. In the illustrative two-country example, the total number of ITMOs generated, transferred and used over the NDC implementation period is the same for all three scenarios, corresponding to 10 million ITMOs over the NDC implementation period.

To assess the implications of the emissions level in the target year, the paper uses an example of how emissions may fluctuate from year to year in the transferring country.

Several simplifying assumptions are made in the analysis. The paper focuses on NDC targets and ITMOs expressed in tons of carbon dioxide equivalent (tCO₂e), acknowledging that countries may also express ITMOs in other metrics. ITMOs are assumed to represent actual emission reductions that are additional and permanent. NDC targets are assumed to be more ambitious than the countries' likely business-as-usual emissions, meaning that the countries do not over-achieve their targets without pursuing mitigation action, a situation sometimes referred to as 'hot air' in the context of the Kyoto Protocol (Boehringer, 2000; Brandt & Svendsen, 2002; den Elzen & Roelfsema, 2009; Kollmuss et al., 2015; La Hoz Theuer et al., 2019; Woerdman, 2005). As a simplification, all scenarios also assume a linear pathway of ITMO engagement. Consistent with the Article 6.2 guidance from Glasgow, it is assumed that ITMOs are not banked from one NDC implementation period to another. Finally, countries are assumed to take the necessary action to achieve their NDC targets. While these assumptions are simplified, they are helpful to illustrate that even under 'ideal' conditions aggregated emissions may increase through the choice of accounting approaches. Section 4 discusses the implications if some of these assumptions are dropped.

4. Assessment of environmental integrity implications

This section evaluates how the choice of the accounting approach, the ITMO engagement trajectory and the level of emissions in the target year affect aggregated emissions from the two countries. Using the two-country example introduced above, the possible implications are first discussed for different scenarios for

how countries could engage in ITMOs over time (section 4.1), followed by a discussion of the influence of the emissions level in the target year (section 4.2).

4.1. Engagement in ITMOs over time

4.1.1. Multi-year approaches

For multi-year approaches, a critical question is how the multi-year target, trajectory or budget is defined. To ensure environmental integrity, ITMOs should represent additional mitigation outcomes that are achieved through the engagement in Article 6. They should not be generated from simply over-achieving an unambitious target and selling the excess budget of emissions. This is ensured if the trajectory or budget represents the emissions path that the country would follow to achieve its NDC target without the engagement in ITMOs, or a lower emissions pathway.

The two example countries introduced above would, without the use of Article 6, achieve their NDC targets by embarking on a constant emissions level of 10 MtCO₂e over the period 2026–2030. Respectively, this linear emissions path is assumed as the target trajectory, or correspondingly a budget of 50 MtCO₂e over that period.

If the trajectory or budget is defined in this way, the engagement in ITMOs does not affect the target achievement of the countries. This is illustrated in [Figure 1](#) for the situation that both the transferring and the acquiring country increase their engagement in ITMOs over time. In the transferring country, the engagement in Article 6 results in lower emissions (blue line) compared to the situation without using Article 6 (dashed line). The increasing engagement in ITMOs is associated with a decreasing emissions pathway. In the acquiring country, the engagement in Article 6 enables the country to have higher emissions (blue line) than without the use of Article 6 (dashed line). The increasing engagement in ITMOs goes along with an increasing emissions pathway.

In the transferring country, the emission reductions achieved through the engagement in ITMOs are equal to the corresponding adjustments applied (green bars), resulting in an adjusted emissions balance (red line) that is equal to the trajectory (dashed line). In the acquiring country, respectively, the increase in emissions enabled through the use of ITMOs is equal to the corresponding adjustments applied (green bars), also resulting in an adjusted emissions balance (red line) that equals the trajectory (dashed line). In consequence, the aggregated emissions from both countries are equal with and without the use of Article 6, totalling 100 MtCO₂e over the period 2026–2030. This holds for all possible combinations of ITMO engagement trajectories between the two countries. Therefore, under multi-year approaches, aggregated emissions from both countries would remain constant, irrespective of how the countries engage in ITMOs over time (see [Table 1](#) further below).

4.1.2. Averaging

Averaging means that the average number of ITMOs transferred or used over the NDC implementation period is accounted for in the single target year (see section 2.2). In contrast to multi-year approaches, averaging can, keeping all other parameters constant, lead to an over- or under-achievement of NDC targets. [Figure 2](#) illustrates this for the same example scenarios as used for multi-year approaches above.

In the transferring country, the increasing engagement in ITMOs results in mitigation outcomes of 4 MtCO₂e in 2030. The country would, however, only apply corresponding adjustments of 2 MtCO₂e in that year (10 million ITMOs transferred over the 5-year NDC implementation period divided by 5 years), resulting in an adjusted emissions level of 8 MtCO₂e. With a target level of 10 MtCO₂e, this leads to an over-achievement of the target by 2 MtCO₂e. This occurs because the emission reductions achieved in the target year through the engagement in ITMOs (4 MtCO₂e, i.e. the difference between the actual emissions in the target year with use of Article 6 and the level of emissions if no transfer had taken place) are larger than the additions of corresponding adjustments applied in that year (2 MtCO₂e).

Due to the over-achievement of the NDC target, the country could implement less climate mitigation action and embark on a higher emissions pathway (2 MtCO₂e in the target year or 5 MtCO₂e over the NDC implementation period in the case of a linear emissions pathway). Alternatively, it could sell further ITMOs that do not need to be backed by actual emission reductions, while still achieving its target (10 million ITMOs in the

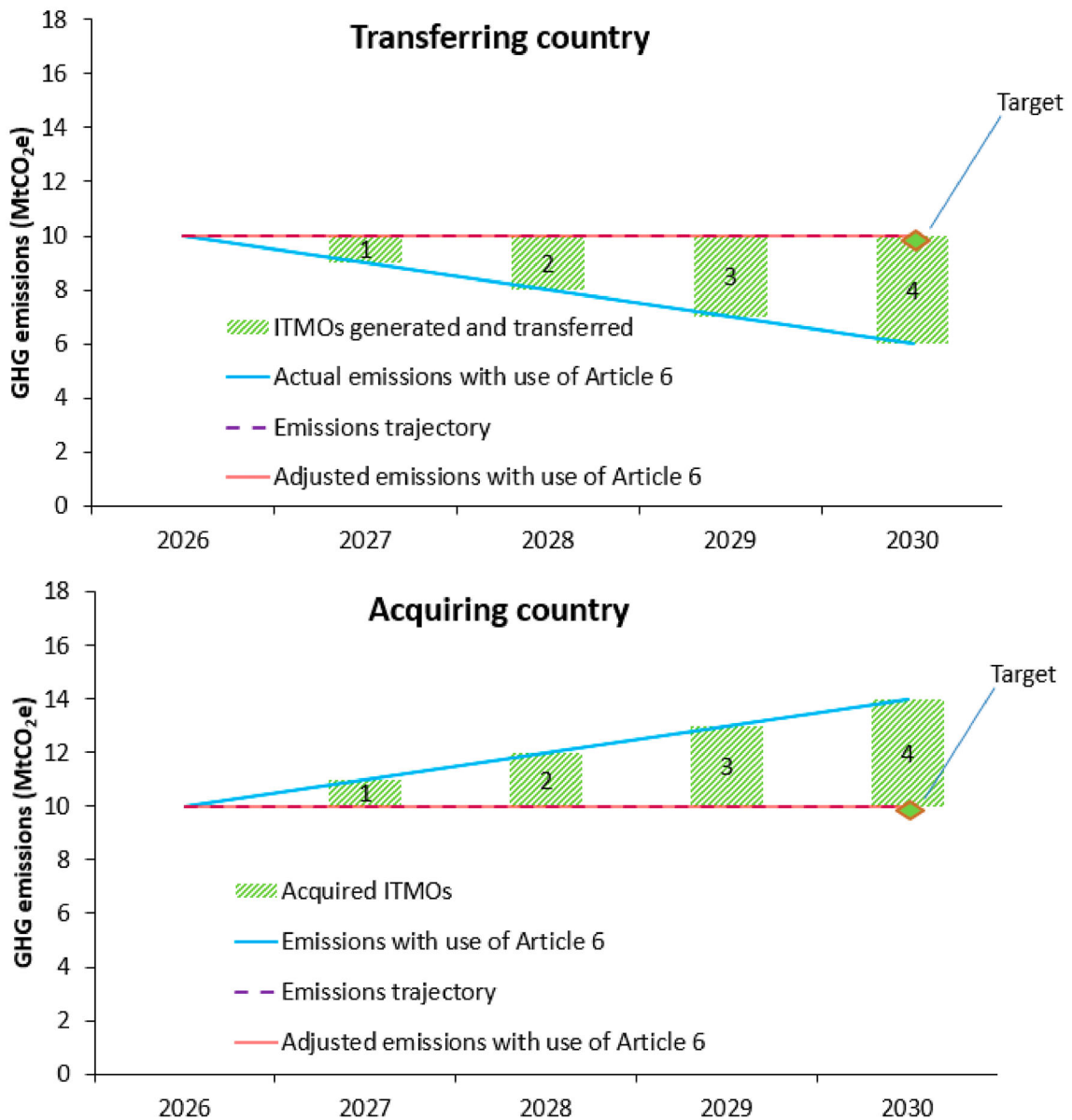


Figure 1. Implications of multi-year approaches on target achievement.

example). In both cases, the emissions from the country would increase compared to the situation that the country would have achieved its NDC target without the engagement in Article 6.

In the acquiring country, the adjusted emissions balance in the target year corresponds to 12 MtCO₂e, whereas the target level is 10 MtCO₂e, leading to an under-achievement of the target by 2 MtCO₂e. This occurs because the increase in emissions in the target year as a result of the engagement in ITMOs (4 MtCO₂e, i.e. the difference between the actual emissions in the target year with use of Article 6 and the level of emissions if no transfer had taken place) is larger than the subtractions of corresponding adjustments applied in that year (2 MtCO₂e). To still achieve its NDC target, the country would need to compensate for this under-achievement and decrease its emissions by a further 2 MtCO₂e in the target year (or, in the case of a

Table 1. Possible effects on aggregated emissions from both countries for different combinations of ITMO engagement and accounting approaches.

			ITMO use is					
			Increasing	Constant Multi-year approaches	Decreasing	Increasing	Constant Averaging	Decreasing
ITMO transfer is	Increasing	Multi-year approaches	No change	No change	No change	Lower aggregated emissions	No change	Higher aggregated emissions
	Constant		No change	No change	No change	Lower aggregated emissions	No change	Higher aggregated emissions
	Decreasing		No change	No change	No change	Lower aggregated emissions	No change	Higher aggregated emissions
	Increasing	Averaging	Higher aggregated emissions	Higher aggregated emissions	Higher aggregated emissions	No change (effects even out)	Higher aggregated emission	Higher aggregated emissions
	Constant		No change	No change	No change	Lower aggregated emissions	No change (effects even out)	Higher aggregated emissions
	Decreasing		Lower aggregated emissions	Lower aggregated emissions	Lower aggregated emissions	Lower aggregated emissions	Lower aggregated emissions	No change (effects even out)

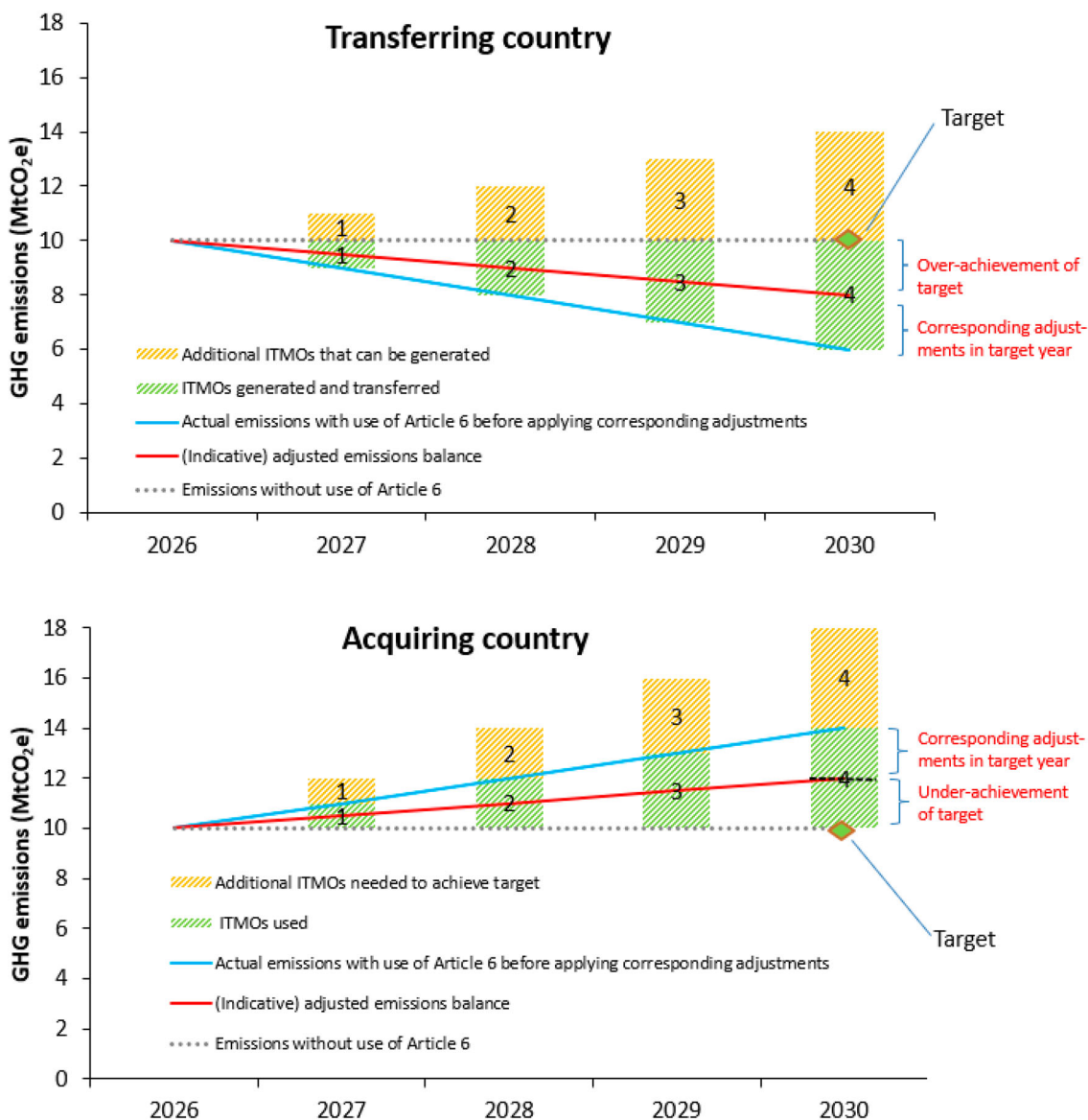


Figure 2. Implications of averaging on target achievement.

linear emissions pathway, by 5 MtCO₂e over the NDC implementation period). Alternatively, the country could acquire an additional 10 million ITMOs. In both cases, the emissions from the country would decrease compared to the situation that the country would have achieved its NDC target without the engagement in Article 6.

In conclusion, averaging affects the ability of countries to achieve their targets whenever the emission reductions achieved in the target year through Article 6 are *larger* or *smaller* than the *average* engagement in ITMOs over the whole NDC implementation period. This applies when the ITMO engagement increases or decreases over time. By contrast, accounting based on averaging has no effect on target achievement if the level of ITMO engagement remains constant over the NDC implementation period. In this case, the corresponding adjustments applied in the target year are equal to the emission reductions achieved (for the transferring country), or the emissions increase enabled (for the acquiring country), in that year as a result of the engagement in ITMOs.

4.1.3. Implications of different combinations of ITMO engagement and accounting approaches

The Article 6.2 guidance adopted in Glasgow allows each country to choose between averaging and multi-year approaches. This flexibility is two-fold: first, the transferring country and the acquiring country may use a different approach; and second, countries need to apply the selected approach consistently throughout an NDC implementation period, but may switch from one approach to another in their subsequent NDC implementation period. It is thus possible that the acquiring and the transferring country apply a different accounting approach.

Building on the scenarios introduced in section 3 and the simplified examples described above, Table 1 summarizes the implications for aggregated emissions for all 36 possible combinations with regard to (1) the accounting approach chosen by each country (multi-year or averaging) and (2) the engagement in ITMOs over time in each country (increasing, constant or decreasing).

If both countries account based on multi-year approaches, the ITMO engagement trajectory has no effect on target achievement. As a result, aggregated emissions from both countries are the same as without any transfers.

If one or both countries choose averaging as the basis for accounting, aggregated emissions from both countries may increase, decrease or remain constant compared to the situation without any transfers. There are three constellations in which aggregated emissions from both countries are not affected, even though the two countries do over- or under-achieve their target as a result of accounting by averaging. This is because, in the specific example used, the amount by which countries over- or under-achieve their target is the same (2 MtCO₂e). As a result, the over-achievement in one country exactly balances the under-achievement in the other country. In practice, however, these constellations may easily lead to a change in aggregated emissions as the ITMO engagement over time may deviate from the simplified examples used in this paper.

4.2. Emissions level in the target year

Next to the ITMO engagement over time, the degree to which the emissions level in the target year is representative of the country's emissions trend can have a considerable impact on aggregated emissions when engaging in Article 6.

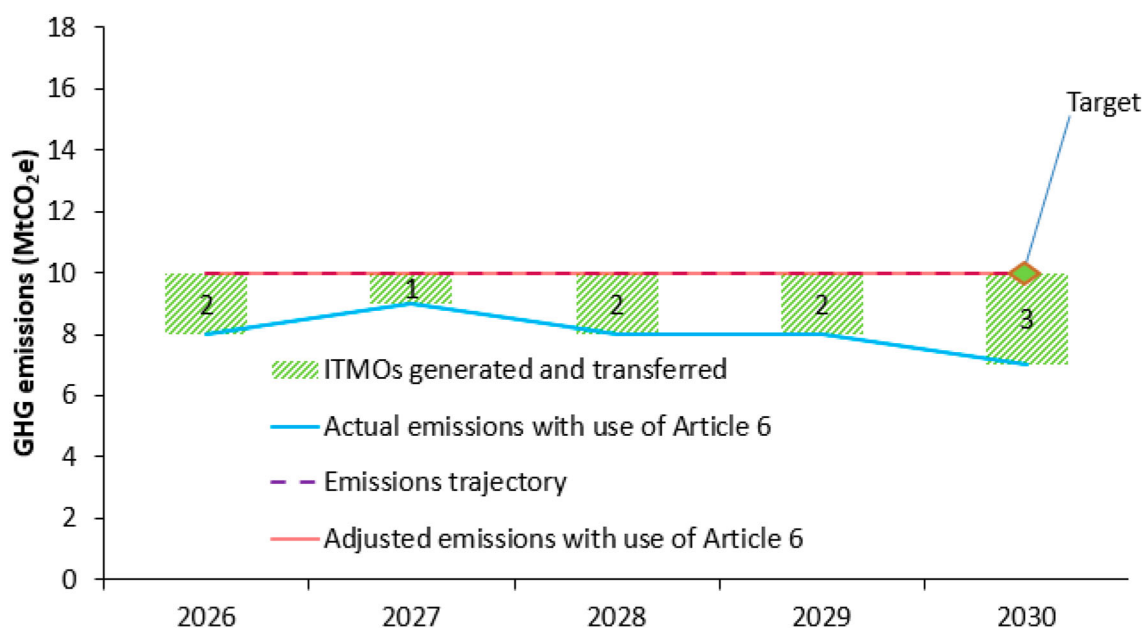


Figure 3. Example of a transferring country that accounts based on a multi-year trajectory with lower-than-normal emissions in the single target year.

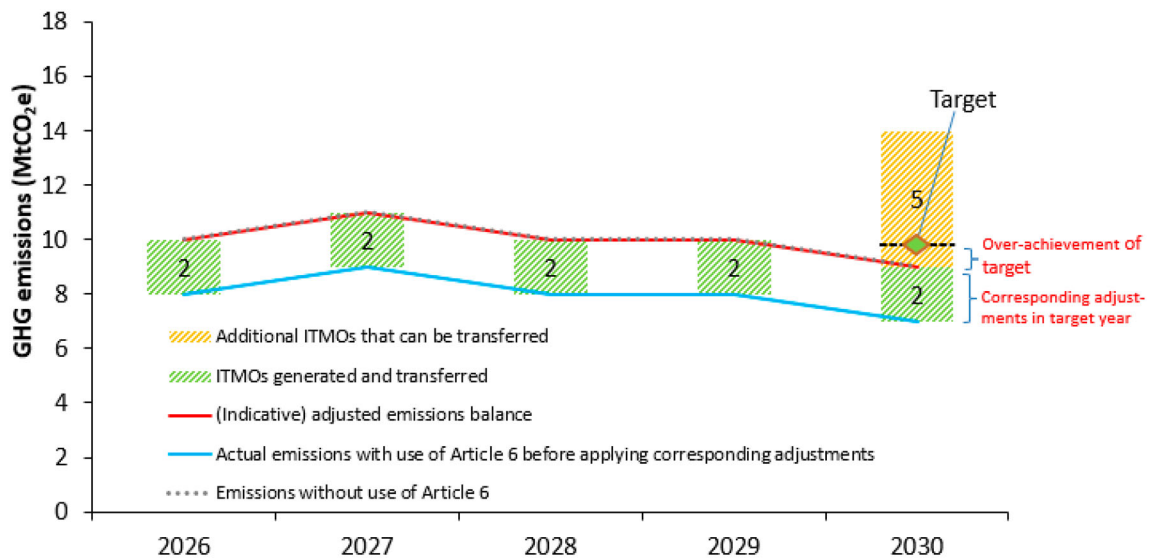


Figure 4. Example of a transferring country that accounts based on averaging with lower-than-normal emissions in the single target year.

Figures 3 and 4 illustrate this for the example of a transferring country with constant engagement in ITMOs, with higher-than-normal emissions in 2027 and lower-than-normal emissions in 2030. Such emission fluctuations are commonly observed and can occur, for example, due to changes in economic activity or weather conditions, such as colder or warmer winters, or lower or higher precipitation levels resulting in changes in hydropower availability.

If the country accounts based on a multi-year approach, the annual fluctuations in emissions have no impact, as the higher emissions in 2027 balance the lower emissions in 2030 (Figure 3). If the country accounts on the basis of averaging, however, it could transfer an additional 5 million ITMOs over the NDC implementation period, without reducing any emissions (Figure 4). This is because the incidental over-achievement by 1 MtCO₂e in the target year enables the country to sell five times the number of ITMOs over the entire NDC implementation period. As the country does not need to take any mitigation action to transfer these additional ITMOs, accounting on the basis of averaging may thus lead to 5 MtCO₂e more emissions than accounting on the basis of multi-year approaches. Respectively, an acquiring country with higher-than-normal emissions in 2030 may need to purchase a significantly larger number of ITMOs over the NDC implementation period in order to still achieve its NDC (cf. Greiner et al., 2019, p. 18). Under averaging, the specific circumstances in the target year have thus a magnifying effect on the number of ITMOs that a country is able to transfer or needs to acquire over the entire NDC implementation period in order to achieve its NDC (Figure 4).

This has several adverse implications. First, averaging can undermine environmental integrity and robust accounting, as aggregated emissions from both countries can increase as a result of engaging in ITMOs. Second, it involves considerable uncertainty for countries as to how many ITMOs they can transfer or need to acquire. For example, unexpected increases in emissions in the target year, e.g. due to a particularly cold winter, could multiply the number of ITMOs acquiring countries need to purchase over the NDC implementation period in order to still achieve their NDC. For transferring countries, lower than expected emissions in the target year, e.g. due to a recession, could seriously undermine environmental integrity, as countries may be able to transfer large numbers of ITMOs without reducing emissions over the NDC implementation period (cf. Greiner et al., 2019, p. 18).

5. Conclusions and recommendations

This paper showed that the choice of the accounting approach – multi-year approaches or averaging – can affect the mitigation effort needed by countries to achieve a given single-year NDC target. Keeping all other

parameters constant, averaging can lead to over- or under-achievement of mitigation targets, depending on whether the country is transferring or acquiring ITMOs, whether it is increasing or decreasing its ITMO engagement over time, or keeping it constant, and whether the countries' emissions in the target year are representative for the countries' emissions trend.

As averaging can lead to an over- or under-achievement of single-year mitigation targets, it can also lead to higher or lower aggregated emissions from both cooperating countries over the NDC implementation period, compared to a situation in which the countries achieved their targets without the use of Article 6. Among 27 scenarios analysed for combinations in which at least one country accounts on the basis of averaging, aggregated emissions over the NDC implementation period increase in one third of the scenarios, decrease in another third, and remain constant in another third.

In theory, as aggregated emissions may increase, decrease or remain unaffected, these effects could cancel out on a global scale with many Article 6 transactions. The Article 6.2 guidance, however, allows countries to freely choose between averaging and multi-year approaches for each NDC implementation period. This could undermine environmental integrity and robust accounting, as countries would have incentives to strategically pick for each NDC implementation period the accounting approach which requires less effort to achieve a given NDC target. This choice would depend on whether the country is intending to transfer or acquire ITMOs and whether it is planning to ramp up or decrease its engagement in ITMO over time.

The use of averaging may be particularly problematic for countries that authorize ITMOs for use under the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) adopted under the International Civil Aviation Organization. CORSIA requires airline operators to offset any increase in their CO₂ emissions from international flights beyond 2019/2020 levels. Demand for carbon credits under CORSIA is expected to increase considerably over time, and so may the generation of ITMOs for CORSIA. If the transferring countries authorized an increasing number of ITMOs over time for use under CORSIA and chose averaging as the accounting approach, however, this would enable them to pursue less mitigation action while still achieving their NDC targets (see [Figure 2](#) above). At the same time, CORSIA pursues a multi-year approach for the buying airlines. This combination of factors – an increasing use of ITMOs over time, the choice of averaging by the transferring countries, and the use of a multi-year approach by the buyer – could lead to an increase in aggregate emissions (see [Table 1](#) above), thereby potentially undermining the mitigation efforts achieved through CORSIA.

Year-on-year fluctuations in emissions, as commonly observed by countries, pose further environmental integrity risks and create uncertainty when averaging is used. With averaging, the emissions level in the target year is decisive for the total number of ITMOs that countries can transfer or need to acquire over the entire NDC implementation period. Any deviations between the reported emissions and the target emissions level magnify the number of ITMOs needed or available for transfer, by a factor of 5 or 10 (depending on the length of the NDC implementation period). As this paper shows, this can lead to higher or lower emissions than if countries had not engaged in Article 6 or used multi-year approaches.

These magnifying effects of year-to-year fluctuations in emissions also involve considerable uncertainty for countries in terms of the number of ITMOs needed or available for transfer. The precise number of ITMOs needed, or available for transfer, will only become apparent after the target year, when GHG inventories for the target year are available. This might have negative repercussions on market dynamics. On the one hand, it may discourage countries from engaging in Article 6 at all. Risk averse countries may sell fewer ITMOs, or purchase more ITMOs than likely needed, in order to ensure that they achieve their targets. In principle, this could lead to more countries over-achieving their targets, thereby implicitly promoting more ambition. On the other hand, some countries might engage in late ITMO trades for activities that started in the past, once they realize that they will over-achieve their NDC in the target year. In this case, the use of averaging would undermine environmental integrity. The implications for ambition and environmental integrity will thus also depend on the behaviour of countries in practice. Finally, averaging may also distort incentives from carbon markets, as emission reductions achieved in the target year have a higher value to countries than emission reductions achieved in other years.

This paper used a simplified example of two countries to illustrate possible outcomes on aggregated emissions. The findings of the paper would also hold if countries did not have constant but decreasing or increasing emissions pathways without the use of Article 6 or if countries engaged in a larger or smaller quantity of ITMOs

than assumed in this paper. Similarly, the findings hold if more than two partners would engage in a cooperative approach under Article 6. In some cases, however, the findings hinge on the specific assumptions made in this paper. For example, if countries had a strongly fluctuating engagement in ITMOs, without a clear trend, the impact of the accounting approach on total emissions would depend on the specific situation of the country. Furthermore, if countries enhanced the ambition of their NDCs because of the possibility to engage in Article 6, this enhancement in ambition may outweigh the possible increase in aggregate emissions due to the use of averaging, noting however that the overall ambition may still be lower compared to the situation that countries had engaged in robust multi-year trajectories. Further research would be necessary in order to model and assess the possible impacts of the two accounting approaches if applied to the specific real-world situation of two cooperating partners.

Altogether, averaging is a problematic accounting approach in the context of single-year targets. Its main advantage is that it is simple to implement and does not require countries to establish multi-year trajectories or budgets. However, while averaging considers ITMO activity over the full NDC implementation period, the circumstances in the target year are decisive for the total number of ITMOs that countries can transfer or need to acquire. As countries can strategically choose for each NDC implementation period the accounting approach that is most favourable to them, averaging can undermine environmental integrity by increasing aggregated emissions compared to a situation in which countries achieved their targets domestically or had used robust multi-year approaches. These challenges should be considered as part of the further work on the 'representativeness' of averaging that countries agreed to conduct in 2022 (UNFCCC, 2021, paragraph 3).

Accounting based on multi-year approaches is, in principle, a more robust accounting approach than averaging, and comes with essential advantages. Most importantly, if both the transferring and the acquiring country implement accounting based on multi-year approaches, aggregated emissions are not affected, as long as multi-year trajectories reflect the emissions path that the countries would follow to achieve its NDC target without engagement in Article 6. Multi-year approaches also provide certainty regarding the cumulative emissions over the NDC implementation period and enable continuous accounting over different NDC implementation periods. This makes accounting for NDC targets compatible with emissions trading systems and crediting mechanisms. It also accommodates different NDC target time frames without requiring the NDC to be formally updated.

However, multi-year approaches also involve several disadvantages. First, a key challenge is establishing credible trajectories or budgets. An increase in aggregated emissions is only avoided if trajectories or budgets are defined based on the emissions pathway that the country would follow to achieve its NDC without engagement in Article 6, or a lower emissions pathway. However, countries may have incentives to define loose multi-year trajectories in order to ensure that they will meet their future targets. To address this risk, countries decided at COP26 in Glasgow to elaborate further guidance on methods for establishing multi-year trajectories (UNFCCC, 2021, paragraph 3). Most objectively, trajectories may be set for all countries on a linear basis over the NDC implementation period, similar to the conversion of 2020 targets communicated by countries in the context of the Cancun commitments into emissions budgets of 'assigned amounts' inscribed in Annex B to the Kyoto Protocol. The starting point of the linear trajectory is, however, a critical choice. It could be based on the level of actual emissions at a certain point in time (e.g. when the country communicated its NDC or the start of the NDC implementation period) or on previous targets levels (e.g. 2020 targets). Next to further international guidance on implementing multi-year approaches, proposed trajectories or budgets could also be scrutinized as part of the review processes under Articles 6 and 13 of the Paris Agreement.

Second, defining an emissions trajectory or a budget of total admissible emissions implies an enhancement of single-year targets. Even though defining a trajectory might be politically more palatable than formally updating the NDC with a multi-year emissions target, it might not correspond to the original intention of the country to re-define its single-year target and may thus imply political challenges. For some developing countries, enhancing their single-year targets to multi-year approaches could also be technically challenging. A specific disadvantage of budgets is that they might create expectations regarding the use of unused emissions surpluses without generating mitigation outcomes. To ensure environmental integrity, however, it is crucial that ITMOs do not result from over-achieving an (unambitious) target and selling the excess budget of emissions.

Based on these considerations, countries engaging in Article 6 should move over time towards robustly defined multi-year targets or trajectories, rather than using averaging or establishing emissions budgets. The risks associated with inflating multi-year trajectories should be addressed through international guidance on the establishment of trajectories and international review processes. Developing countries should be supported through technical assistance in establishing such trajectories. Overall, the implications of multi-year approaches and averaging will only become fully apparent after the rules for accounting under Article 6 have been applied to the first NDCs.

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