Beyond Current Initiatives: Operationalizing the Paris Temperature Target

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Abstract

The international climate policy regime comprises various principles, obligations, and partnerships. A critical assessment of existing international arrangements shows that they are insufficient to achieve the Paris Agreement temperature target. While Internationally Transferred Mitigation Outcomes (ITMOs) aim to make emission reductions more efficient, their unfettered use could actually weaken the domestic ambition of countries buying them. To bolster ambition and align Nationally Determined Contributions (NDCs) with the Paris target, this paper proposes that a coalition of the willing commit to additional rules governing the use of ITMOs. Participating countries would cooperate on the determination of their NDCs to ensure joint alignment with the Paris target, and would commit to not exchanging ITMOs with countries maintaining lenient NDCs. The paper concludes by comparing alternative proposals to strengthen the international climate policy regime.

Keywords: Climate policy; carbon price; ITMOs; carbon trading.
JEL: Q56; F38; H23; Q54; H87; F64; Q58; F53; F35.

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1 Introduction

At COP29 in 2024, the international community finalized the rules for operationalizing Article 6 of the Paris Agreement, which allows cross-border carbon trading. In this paper, I discuss the consequences of Article 6.2, which allows carbon trading at the Intergovernmental level in the form of Internationally Transferred Mitigation Outcomes (ITMOs). There is a risk that the unfettered use of ITMOs could result in the weakening of climate action. While authors such as Michaelowa et al. (2019) have proposed restrictions on the use of ITMOs to ensure that they do not undermine existing ambition, I propose more stringent rules to strenghten ambition and align carbon trading with the Paris Agreement temperature target.

On a related topic, Michaelowa et al. (2022) offered recommendations to strengthen the integrity of voluntary carbon markets, which eventually inspired certain rules operationalizing Article 6.4 of the Paris Agreement (UNFCCC 2025). With this article, I contribute to the parallel debate on how ITMOs can be used to ratchet up ambition. In particular, I make the case for a coalition of the willing that jointly aligns its NDCs with the Paris target and commits not to exchange ITMOs with countries outside the coalition. Beyond this proposal, the article also provides a broad overview of existing and potential international climate policies.

To put the issue into context, Section 2 starts with a critical assessment of the current international climate policy regime, including but not limited to ITMOs. In Section 3, I discuss various proposals on how to align ITMOs with the Paris temperature target. I start by describing existing proposals by Michaelowa et al. (2019) and La Hoz Theuer et al. (2019) as well as their limitations. Then, I propose several options for leverarging ITMOs to enhance climate ambition, with increasing levels of stringency (see Table 1). In Section 4, I discuss alternative proposals to strenghten climate action, from differentiated carbon price floors to a fossil fuel non-proliferation treaty. Finally, Section 5 concludes.

2 A critical assessment of the current regime

The international climate policy regime is established by the United Nations Framework Convention on Climate Change (UNFCCC) and the Paris Agreement adopted under it, which sets a global temperature target. The global consensus supporting this regime is an immense success: the UNFCCC has been universally adopted, and the Paris Agreement had been ratified by all countries but three (Iran, Libya, and Yemen) before the U.S. withdrawal. However, reliance on consensus for decision-making within the UNFCCC results in major limitations: agreements reflect the lowest common denominator and fall short of driving any substantial progress on international climate action. In this section, we review the current regime and its most likely developments.

2.1 Developed nations taking the lead

The UNFCCC introduces a distinction between developed and developing nations: the former shall provide financial resources to the latter to promote their sustainable development and climate action. While aimed at fairly sharing the costs of climate action, this classification dates from 1992 and is now outdated. For example, while Singapore, South Korea, Saudi Arabia, and Slovenia are all wealthier than Greece, only the latter is classified by the UNFCCC as a developed country with financial obligations (Pauw et al. 2024). This outdated classification stalls progress in critical negotiations, as newly high-income countries resist being reclassified as developed, and historically developed countries are reluctant to increase their contributions unless all high-income countries do so (Earth Negotiations Bulletin 2024b; EU Council 2024; Schalatek 2024).

While high-income countries are obligated to provide resources to foster climate action in lower-income countries, the determination of required transfers would be more appropriately based on up-to-date, continuous indicators such as GNI per capita, rather than an outdated binary classification. A simple yet fair rule would be that a country's contributions should be made in proportion to GNI and entitlements in proportion to population (Fabre 2025).

2.2 CBDR

In its Article 1, the UNFCCC codifies what is now known as the *CBDR* principle: "Parties should protect the climate system (...) on the basis of equity and in accordance with their common but differentiated responsibilities and respective capabilities." This article is commendable in its objective to guide the allocation of climate action burden and reconcile different burden-sharing principles: common action, equity, historical responsibility, and ability to pay. Unfortunately, the CBDR principle offers only vague and inconsistent guidance. For example, does equity refer to equal per capita emissions rights or to something else, such as equal cost share of emission reductions or equal access to development? How should policymakers balance rules that result in divergent allocations of emissions rights, such as common action, equal per capita entitlements, historical responsibilities, and ability to pay? As the key issue of the burden-sharing rule was left unresolved by the CBDR principle and its various possible interpretations, countries have not been able to agree on binding targets for emission reductions and financial transfers between countries.

2.3 NDCs

This absence of consensus on burden-sharing led to the system of Nationally Determined Contributions (NDCs), whereby each country sets its own targets. Currently, countries are not sanctioned for missing their targets. Furthermore, they do not have to define their targets using a common indicator (e.g., future cumulative emissions). As NDCs rarely specify a cumulative emissions target, researchers need to formulate hypotheses

to assess whether NDCs are jointly consistent with the universally agreed temperature target.[1] Even under the most optimistic hypotheses, NDCs are insufficient to meet the temperature target. If all countries respect their NDCs, global GHG emissions are projected to be 51 $GtCO_2e$ in 2030, while 41 Gt would be needed to meet the 2 °C target with 66% probability (den Elzen et al. 2022). According to Climate Action Tracker, current policies and actions correspond to a global warming of +2.6 °C by 2100, with warming potentially continuing to rise beyond that date.

2.4 Climate finance

Substantial international transfers are required to achieve the Paris temperature target under a fair allocation of the remaining carbon budget. An equal per capita allocation of emissions rights would entail transfers of 0.4% of global GDP from high to low emitters (on average between 2030 and 2080). North-to-South transfers would amount to approximately $1.5 trillion in 2035 and would exceed $1 trillion annually until 2060.[2] Taking historical responsibility for emissions into account, an equal per capita allocation of cumulative (past and future) emissions rights would entail even larger transfers; the "carbon debt" that the North owes to the South is estimated at $26 to $192 trillion (Fabre 2024; Fanning & Hickel 2023).

At COP29, the international community reached a compromise on the New Collective Quantified Goal (NCQG). Developed countries committed to mobilizing $300 billion per year by 2035 for climate action in developing countries. Moreover, Parties to the UNFCCC "call on all actors" to mobilize $1.3 trillion, which would be in line with experts' recommendations (Songwe et al. 2024; UNFCCC 2024). The quantum of $300 billion represents a tripling of the previous climate finance goal. However, it can be reached through loans (including from the private sector), and does not specify what share should be provided as grants (or grant-equivalent concessional loans). In fact, the current goal of $100 billion is met with only $26 billion provided as grants (OECD 2024). In theory, the NCQG could be met with the same amount of grants (i.e. North-to-South transfers), or even less.

In contrast, at COP29, "India specified that the NCQG should mobilize $1.3 trillion, of which at least $600 billion should come in the form of grants and equivalent resources" (Earth Negotiations Bulletin 2024a). The Indian representative, voicing Global South concerns, stated: "We are disappointed in the outcome which clearly brings out the unwillingness of the developed country parties to fulfill their responsibilities. We cannot accept it." Transfers aligned with the Global South's demands would enable enormous progress towards the Sustainable Development Goals, including climate action, but also the de-

[1] Note that the temperature target is itself vague. Article 2 of the Paris Agreement aims at "holding the increase in the global average temperature to well below 2 °C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5 °C above pre-industrial levels." Yet, given the uncertainty inherent in the climate system, this (double) target is not precisely defined: does it imply an 83%, 67%, or 50% chance to limit global warming to 2 °C? Each probability is associated with a different carbon budget – respectively 900, 1,150, and 1,350 $GtCO_2$ from 2020, according to the IPCC (AR6, WGI, p. 39).

[2] I computed these figures using the model NICE under a 1.8°C scenario.

ployment of public services and poverty reduction programs. Conversely, an insufficient provision of climate finance not only infringes on climate justice but also jeopardizes decarbonization in the Global South, as many countries condition their NDC on the adequate provision of climate finance.

Together with increased North-to-South transfers, reforms to the international financial system are needed to reorient resources towards climate action. These reforms are multifaceted and are more likely to be accepted by governments in the Global North than direct transfers, since they rely on largely painless, growth-enhancing accounting operations. The government of Barbados (with the support of the UN Secretary-General) leads the movement in favor of these reforms. Their "Bridgetown Initiative" calls for debt relief for low-income countries, a new issuance of at least $650 billion in Special Drawing Rights by the IMF to expand loans of Multilateral Development Banks (MDBs) to at least $500 billion per year, and public guarantees to lower interest rates on sustainable projects in the Global South (Bridgetown Initiative 2025). Note that although the Bridgetown Initiative is best known for its climate finance proposals, it also calls for other reforms, such as a universal carbon price and international taxes on the super-rich to finance global public goods.

While scaling up climate finance is crucial, it is not sufficient to decarbonize the world, as it does not cap (or directly reduce) emissions. In the worst-case scenario, the expansion of low-emission projects would merely add low-carbon infrastructures on top of fossil ones, failing to meaningfully reduce emissions.

2.5 JETPs

Just Energy Transition Partnerships (JETPs) are agreements where a developing country essentially commits to emission reductions through the deployment of renewable energy in exchange for concessional terms on the required loans provided by a group of developed countries. Four JETPs have been signed to date, involving Indonesia, Vietnam, South Africa, and Senegal (Ha-Duong & Cassen 2023). In existing JETPs, the groups of developed countries pledged to offer loans ranging from $2.5 billion (for Senegal) to $20 billion (for Indonesia).

While JETPs offer a promising way to deliver climate finance that guarantees emission reductions, they currently suffer from several shortcomings. First, their coverage is limited regarding sectors and countries. To improve sectoral coverage and efficiency of JETPs, researchers have proposed designing them as financial transfers in exchange for a national carbon price (Steckel et al. 2017). Second, as they focus on emission reductions rather than sustainable development, JETPs do not contribute to poverty reduction. This concern could be mitigated by designing JETPs with a higher reliance on grants (Bolton et al. 2025). However, increasing the provision of grants is difficult absent a dedicated source of revenue (such as an international tax). Lastly, even if JETPs were improved accordingly, they would still fail to guarantee that the decarbonization of major emitters like China or the European Union is consistent with necessary global efforts.

2.6 ITMOs

Article 6.2 of the Paris Agreement allows Parties to exchange Internationally Transferred Mitigation Outcomes (ITMOs). This enables a country to nominally reduce its emissions (for the purpose of NDC assessment) by purchasing verified emission reductions from another country. The purchased ITMOs are then added to the emissions account of the seller country through a corresponding adjustment.

As any bilateral agreement on ITMO is permitted, the use of ITMOs risks reducing buyers' domestic decarbonization efforts. Indeed, to the extent that the NDCs do not add up to the global emission reduction objective, there will be some "ambition gap": ITMOs will not reflect the required mitigation constraint, and their price will be too low. As a result, ITMOs may propagate a global lack of ambition to countries with otherwise ambitious NDCs, offering a cheap (and less effective) alternative to domestic decarbonization.

To illustrate this, consider a fictive example with two world regions, Rich and Poor, each containing half of the global population. Assume the global carbon budget is 1,000 Gt and that in a business-as-usual scenario without climate action, both regions would emit 750 Gt. Imagine that region Rich sets an ambitious NDC of 500 Gt, while Poor sets a low ambition NDC of 1,000 Gt. In the absence of international carbon trading, region Rich would be expected to emit 500 Gt (in line with its NDC) and region Poor to emit 750 Gt (as no climate action is required to fulfill its NDC). In this example, region Poor may be willing to sell 250 Gt of ITMOs to region Rich at a very low price. Region Rich could then meet its NDCs while emitting 750 Gt, resulting in global emissions of 1,500 Gt, higher than the 1,250 Gt that would have occurred without ITMOs.

According to Climate Action Tracker, the sum of current NDCs would lead to global warming of around 2.6°C, far above the Paris target of "well below 2°C." In such a context, international carbon trading risks becoming a vehicle for exporting low ambition rather than reinforcing collective effort. Buyers will find it more attractive to purchase credits abroad than to accelerate the domestic transformation of their economies. In short, unregulated ITMOs can result in "emissions dumping".

This dynamic is already apparent. The European Union now allows the use of international credits toward its 2040 climate target. More precisely, up to 5% of 1990-level emissions could be offset through ITMOs (European Parliament 2025). Since the European Commission aims to cut EU emissions by 90% by 2040, relying on ITMOs could enable the EU to emit 50% above its 2040 domestic goal through purchasing emission reductions abroad. Likewise, Japan plans to emit up to 53% above its goal in 2040 (Japan 2025). Switzerland has already purchased ITMOs from Thailand and Ghana and may rely on ITMOs for over 50% of its 2035 goal. Adding intended purchases from South Korea, Norway, and Singapore, the market for ITMOs could reach 500 $MtCO_2$ per year by 2040.

Meanwhile, China pledges to reduce emissions by 7–10% from their peak by 2035 (China 2025). Yet, a reduction of around 20% would be needed to align with a 2°C scenario (He et al. 2022). If China or other countries were to sell ITMOs based on such lenient trajectories, buyers would acquire credits that do not represent genuine progress toward the Paris goal.

To prevent ITMOs from weakening domestic action, countries that use them should commit to extra rules that go beyond merely verifying the environmental integrity of the credits. I discuss such rules in the next section.

3 Aligning Carbon Trading with the Paris Temperature Target

3.1 Existing proposals

Michaelowa et al. (2019) propose verifying that ITMOs are additional, meaning they correspond to emission reductions relative to a counterfactual scenario without such ITMOs. The authors suggest a two-step procedure wherein new "Article 6 Supervisory Board" would first check whether the seller's NDC is more ambitious than the business-as-usual (BAU) trend. If qo, the second step is unnecessary. Otherwise, the seller's unambitious NDC generates "hot air", requiring ITMO to be tested at the project level. In this second step, the additionality of each specific activity financed by the ITMO would be assessed individually.

La Hoz Theuer et al. (2019) discuss restricting ITMOs to emission reductions below the BAU. They compute BAU emissions for a range of countries using four potential definitions for the BAU: extending past emissions levels, extending emission intensity, or projecting their respective historical trend. They show that none of these definitions is satisfactory, as each would still generate *hot air* for some countries where to the BAU exceeds emissions as projected by Climate Action Tracker. The authors propose instead to limit the quantity of ITMOs that a country can sell to a fixed share of its emissions (e.g. 1% or 5%). They acknowledge that quantity limits would still allow some hot air but argue that such limits can be calibrated to strike a balance between reducing hot air and exploiting the gains from trade.

While La Hoz Theuer et al. (2019) show that simple definitions of the BAU are ill-suited for regulating ITMOs, Michaelowa et al. (2019) propose delegating the determination of the BAU to independent experts so that NDC ambition can be accurately assessed.[3] In both papers, the authors agree that an NDC can be assessed at the national level, by comparing it to the country's projected emissions, and that ITMOs should be allowed whenever the NDC is more ambitious than properly projected emissions.

3.2 Desirable paths to regulate carbon trading

Principled buyers of ITMOs could also emply other national criteria to assess the adequacy of a seller's NDC.

[3]Expert projections of BAU emissions already exist, see e.g. den Elzen (2024); den Elzen et al. (2023).

A necessary precondition: harmonized NDCs. Currently, few constraints apply to the definition of NDCs. Countries independently choose their sectoral and gas coverage, the methods for converting different gases into CO_2-equivalent, and whether to use an absolute or carbon intensity target, etc. As a result, NDCs are not harmonized. Researchers must make assumptions (e.g. on GDP growth or LULUCF emissions) to express them using a comparable metric, and estimates of NDC targets vary significantly across research teams.[4]

A necessary precondition to assessing NDCs is the strengthening of reporting requirement. NDCs should cover all Kyoto gases and be expressed in absolute terms using harmonized conversion factors between gases (GWP100, the most up-to-date being from the IPCC AR6). Furthermore, they should encompass all sectors—broken down individually, or at least separating LULUCF from non-LULUCF emissions. Ideally, NDCs should also specify a country's future cumulative emissions, its planned emission trajectory, and the intended use of ITMOs. These enhanced reporting requirements would allow for the proper assessment of NDCs and enable conditioning the use of ITMOs on the achievement and adequacy of NDCs.

A sine qua non condition: no ITMOs from failed NDCs. As a minimal requirement, countries should be allowed to sell ITMOs only up to the amount by which their emissions fall below their NDC targets. Consequently, buyers should refrain from purchasing ITMOs from a country that is failing to meet its NDC target. This principle should also apply to countries that have weakened their emission targets (instead of ratcheting up ambition), resulting in emissions higher than planned under a previous target.[5]

Principled buyers: no ITMOs from lenient NDCs. Furthermore, to strengthen the additionality requirement proposed by Michaelowa et al. (2019), principled buyers should refuse to buy ITMOs from a country whose NDC target is above the BAU or evidently incompatible with the Paris target, even when it is below the BAU. Such incompatibility could be safely assumed when a country's NDC target exceeds both its cost-optimal emissions required to limit global warming to 2°C and above its equal per capita share of global emissions under that 2°C scenario. Given that there are multiple ways to define a cost-optimal 2°C scenario (as the carbon budget depends on the probability of achieving the 2°C target, while the trajectory depends on the model used), simple substitutes could

[4]Estimates of emissions implied by NDC targets are provided by Climate Action Tracker, UNDP, Climate Analytics, Climate Resource, PBL, Climate Watch, den Elzen et al. (2022); Nascimento et al. (2024).

[5]Angola provides a clear example of a country that effectively decreased its ambition in an updated NDC. Its first NDC defined a 2030 business-as-usual (BAU) level of 111 $MtCO_2eq$. Later, "improved national inventories, more robust methodologies and enhanced transparency mechanisms" led to a revised BAU estimate of 226 $MtCO_2eq$, roughly double the original figure. This recalculation allows the country to claim higher absolute emission reductions while committing to a lower mitigation rate, ultimately resulting in higher projected emissions for 2030 or 2035. According to the first unconditional NDC, 2030 emissions would have been 88 $MtCO_2eq$. By contrast, assuming a linear trajectory from the 2035 target in the latest NDC back to 2020, the implied 2030 level rises to 202 $MtCO_2eq$.

be employed instead. In particular, buyers could refuse to acquire ITMOs from countries with per capita emissions or GDP above the world average (subject, perhaps, to an exception if their historical and target emissions are compatible with a 1.5°C scenario).

The only exchange of ITMO that has occurred to date is between Thailand and Switzerland. Thailand appears to meet all aforementioned criteria, suggesting that Switzerland could be considered a principled buyer. However, until the sum of all countries' NDCs aligns with the Paris target, the price of ITMOs might be too low. In other words, the above requirements are necessary but not sufficient conditions to close the ambition gap.

Adequate climate finance. While these requirements would reduce the amount of hot air, they would exclude from the trade of ITMOs low-emitting countries that set their NDC target above the BAU,[6] at (what they consider to be) their fair share. These potential sellers of ITMOs could join forces and use their market power to negotiate guarantees of grant-based climate finance at scale. In particular, these countries could commit to setting their NDC target below the BAU (and selling ITMOs) in exchange for a commitment from buyers to fairly allocate taxing rights for new international levies, or to finance JETPs or debt relief. Alternatively, the conditional NDC target could replace the unconditional target in the adequacy assessment once a country's conditions (in terms of climate finance) are met. In both cases, sellers would incentivize principled buyers to provide sufficient climate finance.

3.3 Limitations of the previous options

Issues with national assessments of NDCs. The aforementioned proposals (including those by La Hoz Theuer et al. 2019; Michaelowa et al. 2019) rely on assessing NDCs against national BAUs. However, this approach raises two issues. First, even if a country's NDC target is set below its BAU, to the extent that NDCs do not align with the Paris temperature target when aggregated at the global level, the ambition gap will persist. Consequently, both the demand for ITMOs and their price will remain too low. Second, given that grant-based climate finance falls short of their demands, Global South countries could legitimately set up unconditional NDC emission targets above their BAU emissions to use extra emission space to sell ITMOs. Indeed, insofar as NDC targets represent how countries should share the burden of emission reductions, low-income countries already claim less than their fair share of emissions.[7] Therefore, the ratcheting up of ambition should arguably be borne by industrialized countries. For these reasons, assessing an NDC against the national (or project-based) BAU is neither a fair nor effective way to

[6] For example, van den Berg et al. (2020) conclude that India has set its 2030 NDC above the BAU (note that the BAU trajectory was computed by the authors; India's NDC does not specify a BAU).

[7] Based on my own estimates, the 2030 NDC targets of Global South countries (excluding China) total 13.5 $GtCO_2$, that is 2.8tCO_2 per capita, which is below equal per capita emissions aligned with the Paris target.

close the ambition gap.

A rule restricting the sale of ITMOs to cases where the NDC target is below the BAU would be satisfactory only at a global scale or within a large coalition, since this is the scale at which there is consensus that the BAU is inadequate. Conversely, at the national level, some countries may have already implemented stringent climate policies such that their BAU emissions are ambitious enough, while others would legitimately set an NDC target above their BAU since they deserve to sell ITMOs. In both cases, a national comparison of the NDC to the BAU would be inappropriate.

The key problem with ITMOs is that the *global* emissions implied by current NDCs (or current trends) do not align with the Paris temperature target. Meanwhile, given the disagreement over what constitutes a fair share of the global carbon budget, countries cannot agree on whether a given NDC complies with the Paris target or claims an excessive carbon budget. However, if a critical mass of countries agreed on a common norm, such as a burden-sharing principle or on a decision rule to assess whether the global carbon budget is fairly shared, then the two issues of effectiveness and fairness could be resolved.

Limitations of restrictions to the use of ITMOs. As Mehling (2019) explain, restricting the use of ITMOs involves a trade-off between limiting hot air and exploiting gains from trade. Furthermore, the restrictions discussed above present additional limitations. The proposed restrictions rely on arbitrary cutoffs, which create undesirable discontinuities in the ability to sell ITMOs. Additionally, they do not provide an institution for states to negotiate common ground regarding overall ambition or the scale of climate finance. Yet, conflicting goals must be resolved. For example, while some desirable goals imply more stringent NDC targets (to raise ambition by lowering the sum of targets well below the BAU or even aligning them with a 1.5°C scenario), other desirable goals call for more lenient targets for countries with moderate emissions (such as an equal per capita entitlements to emissions in a 2°C scenario).

A coalition of willing countries could arbitrate between these conflicting goals and establish precise norms for NDC adequacy and climate finance contributions. The adoption of such norms by a large group of countries would alleviate the need for restrictions on ITMO exchanges between them (beyond the sine qua non condition) and overcome the aforementioned limitations.

3.4 The case for a joint definition of NDCs

A coalition of the willing could even go further and submit a joint NDC (just as the European Union does). The common norm would be used to verify that the joint NDC complies with the global target and thereby closes the ambition gap. This coalition could also allocate its aggregate NDC between countries in a way deemed acceptable and fair, potentially allowing certain countries to get a target higher than their BAU emissions.

Ideally, the joint NDC would include a carbon budget aligned with the Paris target, broken down into yearly national targets. Alternatively, the joint NDC would define

Table 1: Proposals to strengthen ambition using ITMOs or NDCs. Restrictions based on national assessments of NDCs are denoted with *Nat*, those based on BAU trajectory are denoted with *BAU*.

Policy	Type	Description
Harmonized NDCs		NDCs should cover all sectors and GHGs, use an absolute target, and specify cumulative emissions.
ITMOs should be additional (Michaelowa et al. 2019)	Nat, BAU	ITMOs should either be sold by a country whose NDC target is below the BAU, or their additionality verified at the project level.
ITMOs should be limited (La Hoz Theuer et al. 2019)	Nat	ITMOs should not exceed a fixed share (e.g. 1% or 5%) of the seller's emissions.
No ITMOs from failed NDCs	Nat	ITMOs sold should not exceed the difference between the NDC target and actual domestic emissions.
No ITMOs from lenient NDCs	Nat, BAU	ITMOs should not be bought from a seller with a lenient NDC target, i.e. a target above the BAU or both above cost-optimal and equal per capita 2°C emissions.
No ITMOs from rich or large emitter	Nat	ITMOs should not be bought from a seller with per capita GDP or emissions above the world average.
Adequate climate finance		Potential sellers would set their NDC target below the BAU in exchange for adequate climate finance.
Conservative use of the conditional target		A seller's conditional NDC target would replace the unconditional one in national adequacy assessments iff climate finance conditions are met.
ITMO coalition with a joint NDC		A coalition of countries would submit a joint NDC aligned with the Paris target and exchange ITMOs only among themselves. The NDC would ideally specify a carbon budget and yearly national targets.

a minimum emission reduction rate, aligned with the Paris target. Initially, this rate could be expressed in terms of emission intensity, consistent with the practice of emerging economies. For example, the coalition's GHG emissions relative to output or final energy use[8] would need to decrease by 2% each year. In the medium term, the reduction should be defined in absolute terms.

The countries most likely to join such a coalition are those with moderate emissions. Therefore, there is a tension between setting the coalition's carbon budget based on a cost-optimal allocation of global emissions (favoring large emitters outside the coalition) or an egalitarian allocation (which might not sufficiently strengthen decarbonization ambition). Examples of compromises with similar levels of ambition for the coalition's carbon budget include a cost-optimal share of a world carbon budget achieving 1.9°C with a 50%

[8]Although emission intensity is usually defined relative to GDP, it may be more advisable to define it relative to final energy use, as emissions may decouple from GDP more easily than from energy use, and GDP indicators may be more susceptible to manipulation.

probability, or an equal per capita share of a global carbon budget achieving either 1.8°C with a 50% probability or 2°C with a 75% probability.[9] Negotiations within the coalition would be essential to defining fair shares.

3.5 A coalition for the use of ITMOs

Here is how negotiations could shape an agreement along the lines sketched above. A coalition of countries could agree to jointly define their NDCs and exchange ITMOs exclusively among themselves to ensure that their carbon trading does not undermine the ambition of the Paris Agreement. Once a large coalition of countries agree on the broad vision, this coalition could be taken as given. The coalition's emissions targets would be set below its projected emissions, with a gradually increasing wedge between BAU emissions and the target. Specifically, the 2026 target would correspond to the coalition's emissions, while the 2027 target would be slightly below the BAU, increasing the divergence in 2028 and beyond. This would realistically scale up the additional decarbonization effort over time until it reaches an emission reduction rate aligned with the Paris target. The resulting emission trajectory of the coalition should not exceed its equal per capita share of a global carbon budget achieving 2°C with a 75% probability, and would ideally be lower.

After determining the coalition's trajectory, the disaggregation into national targets would be negotiated. It would be useful to allocate national targets starting from a focal point, such as the minimum between the country's BAU trajectory, its NDC targets, and an equal per capita share of the coalition's emission trajectory. Extra emission rights could then be allocated to countries experiencing the greatest welfare loss due to the increased decarbonization effort and to those with the lowest incomes.

If new countries join the coalition, they could propose a new allocation of emission targets. If the proposal is rejected by the coalition, the entire negotiation process would be restarted. The new allocation would then be adopted only if it were accepted by a majority within the coalition and provided it does not lead to reduced emission coverage (resulting from unsatisfied countries leaving the coalition) or to a lower projected ITMO price (which would indicate reduced ambition).

A scientific council would assist the coalition by modelling the climate, economic, and distributive effects of the agreement, providing requested analyses, and proposing target allocations or suggesting other arbitration decisions. Each participating country would be entitled to designate a team of scientists to represent them on the council, and these teams could overlap. In the event of disagreement within the scientific council, each team would hold voting rights proportional to the population of the country (or countries) that designated them.

[9] According to the model NICE by Young-Brun et al. (2025) and extrapolating from the IPCC (2021), for a climate coalition comprising China, the Global South, Europe, and Japan, these three carbon budgets would be close to 750 $GtCO_2$ over 2026–2100 (including LULUCF but excluding non-CO_2 gases).

4 Comparison of alternative proposals for phasing out fossil fuels

In Section 2, we have reviewed the pros and cons of ITMOs, climate finance, and JETPS, which represent the international decarbonization initiatives with the greatest chance of implementation. While these approaches are acceptable to most countries, they generally fail to guarantee sufficient emission reductions. In this section, we assess alternative proposals to either expand carbon pricing or restrict fossil fuel extraction. We then provide three tables summarizing the evaluation of each policy mentioned in this article. Table 2 presents each policy, Table 3 lists their pros and cons, and Table 4 attempts to grade the policies' properties in terms of the multiple desired objectives.

4.1 Differentiated carbon price floors

Some authors propose that all countries in a coalition price carbon nationally without cross-country revenue sharing, but with differentiated carbon price floors based on income levels: \$75/tCO_2 for high-income countries, \$50/t for upper middle-income countries, and \$25/t for lower-income countries (Parry et al. 2021; Wolfram et al. 2025). In a prominent contribution, Wolfram et al. (2025) propose restricting the agreement to carbon-intensive manufacturing products (e.g. steel, aluminium, cement) and applying a carbon border adjustment mechanism (CBAM) only at the borders of the climate coalition (at \$75/t). This proposal would have the EU renounce its own CBAM in exchange for China pricing carbon emissions in its manufacturing sector — thereby increasing the price of its final products (Chateau et al. 2024). This proposal would reduce global CO_2 emissions by 2%. It has little chances of being implemented, as China represents about 70% of emissions covered in the proposed coalition, and China appears unwilling to commit to a carbon price of \$50/t.

One may wonder why carbon prices should be differentiated across countries. From a theoretical perspective, absent any imperfections, a uniform carbon price coupled with cross-country transfers is optimal (Aldy & Stavins 2012). Specifically, a uniform price is more efficient, and under a redistributive system, lower-income countries would gain purchasing power, countering the common belief that they would lack the resources to adapt their economies to a high carbon price. Provided lower-income countries are allocated more emission rights than actual needs, they could in principle choose to keep their emissions stable while receiving a financial transfer. Yet, the high carbon price would provide incentives to decarbonize, allowing them to benefit from larger transfers.

Admittedly, four kinds of imperfections justify differentiated carbon prices across countries or sectors: divergent discount rates, the presence of country-specific distortive taxes, market power in trade, and a constraints preventing cross-country transfers. Let us review them in turn. First, Anthoff et al. (2021) show that equalizing carbon prices across countries is inefficient "if the equilibrium features cross-country differences in discount rates (or interest rates)", themselves due to inefficiencies in the allocation of cap-

ital.[10] However, the authors remain uncertain whether welfare would increase or decrease upon equalizing carbon prices (through emission trading), as assessing this would require a model of capital market frictions and their interactions with carbon trading. Second, Babiker et al. (2004) explain theoretically and Boeters (2014) models numerically that existing distortions can be reduced by differentiating carbon prices across sectors or countries. For example, if aviation remains is under-taxed, then a higher sector-specific carbon price improves welfare. Third, to understand terms-of-trade effect, take the example of China, which possesses significant market power in the oil or manufactured goods markets. As an oil importer, China would benefit from a lower oil price. By taxing oil more than other sectors, China would reduce global demand for oil, thereby lowering its price and improving its terms-of-trade. Similarly, China has an interest in setting a higher carbon price on manufactured goods to increase the value of its exports. Fourth, differentiated prices are generally justified by the assertion that international transfers are politically infeasible (Parry et al. 2021; Young-Brun et al. 2025). Bauer et al. (2020) refer to an "efficiency-sovereignty" trade-off in climate policies: either carbon prices are differentiated and efficiency is lost, or a uniform price is applied alongside transfers to equalize efforts across countries. Bauer et al. (2020) assume that international transfers constitute a stronger infringement on sovereignty than coordinated price differentiation. Because they deem transfers infeasible, they view differentiated prices as a necessary second-best solution.

However, there is a distributional equivalence between differentiated carbon prices and a uniform price with differentiated emission rights (Fabre 2025). More precisely, a uniform price combined with an appropriate allocation of emission rights can replicate the distribution of costs and benefits generated by any differentiated price-floor agreement, while typically delivering the same or greater global emission reductions. This observation should prompt governments to question their apparent reluctance to implement transfers, given that they produce the same distributive effects as differentiated prices without associated inefficiency costs. Even more so given that representative surveys show that transfers would be accepted by the public: Fabre et al. (2025) and Fabre (2025) reveal that majorities around the world would support an international carbon price with equal per capita revenue sharing or other policies involving North-to-South transfers.

4.2 A uniform carbon price with international transfers

Several authors propose that a coalition of countries implement a uniform carbon price and share the revenue internationally (Bertram 1992; Blanchard & Tirole 2021; Cramton et al. 2017; Fabre 2024; Grubb 1990; Jamieson 2001; Rajan 2021). While an equal per capita allocation is viewed as a fair and progressive way to share carbon pricing revenue (Gollier & Tirole 2015; Grubb 1990), small departures from the equal per capita benchmark may

[10] While differentiated carbon prices might be optimal in a second-best world, the first best is in principle attainable through capital market reforms to correct their imperfections.

incentivize more countries to join the coalition and prevent high-income countries from becoming net recipients of transfers (Fabre 2024).

A global cap-and-trade system would guarantee that decarbonization is aligned with climate objectives. Furthermore, it would enforce carbon pricing directly on the firms at the source of emissions, whereas the achievement of NDCs without a global price must rely on the goodwill of governments to develop comprehensive decarbonization plans.

While this proposal receives genuine support from majorities across countries (Fabre 2025; Fabre et al. 2025), key governments may be reluctant to join such a coalition for fear of losing sovereignty. By proposing a regulation of carbon trading more closely aligned with the framework of the Paris Agreement, this paper seeks to reproduce the efficiency and fairness of a redistributive cap-and-trade while leaving countries free to implement the policies of their choice.

4.3 Country-level incentives to decarbonization

To allow countries flexibility in their implementation of carbon pricing, Stoft (2009) proposes a system of monetary rewards for countries based on the extent to which they price carbon above a benchmark or emit less than the average, with symmetric penalties for countries deviating from these thresholds in the other direction. While the increased flexibility compared to has its own limitations. This system does not guarantee that countries will implement sufficiently ambitious decarbonization policies. By rewarding countries with high carbon prices and low emissions, this system may lead to transfers to wealthy countries (such as Norway). Finally, the system relies on the willingness of countries to pay penalties.

Proposals for a "refunding club" aim to restore incentive-compatibility in agreements that rely on international transfers, ensuring that countries are incentivized to pay their dues and remain in the coalition (Finus 2024; Gersbach et al. 2021). These proposals involve country-specific (and potentially negative) initial payments and period-by-period refunds, proportional to countries' mitigation spending. Initial payments can accommodate any burden-sharing allocation. Finus & Maus (2008) estimate that an initial fund of $2.6 trillion (that is, 0.3% of world GDP over ten years) is required to make the grand coalition stable and close half the gap between the non-cooperative and the social optima. Although this amount could in principle be raised through various means, such as a 2% tax on billionaire wealth (Zucman 2024), convincing countries to make the initial payment could prove insurmountable.

4.4 Supply-side policies such as *fossil fuel non-proliferation*

The *Fossil Fuel Non-Proliferation Treaty* has emerged as a prominent campaign to phase out fossil fuels. The call for a treaty (which does not refer to a specific legal proposal) has been endorsed by over one million individuals, four thousands organizations (including Greenpeace and the Climate Action Network International), and 101 Nobel laureates.

While the petition only alludes to a consensual call for a "binding plan to end the expansion of new coal, oil and gas projects and manage a global transition away from fossil fuels"; campaign briefings and related academic research sketch out a more detailed plan (Calverley & Anderson 2022; Fossil Fuel Non-Proliferation Treaty 2023; Review 2021, 2023).

The campaign refers to a plan called the *Fair Shares Phase Out*, which involves setting country-specific end dates for fossil fuel extraction (Calverley & Anderson 2022; Review 2023). This approaches allows a later phase-out for countries with lower incomes or higher dependence on fossil fuel extraction. For example, the U.S. would be required to fully phase out oil extraction by 2031, Russia by 2037, Saudi Arabia by 2041, and Iraq by 2050.

This plan is problematic for three reasons. First, it requires the participation of all countries that export fossil fuels, yet these countries are the least likely to take action on climate change. Second, by restricting supply rather than demand for fossil fuels, this plan would increase fossil fuel rents instead of generating carbon price revenue. Therefore, despite the plan being framed as fair, it would probably widen inequality compared to demand-side policies, since (predominantly rich) owners of fossil fuel resources would benefit while the lack of carbon pricing revenue would make it difficult to compensate low-income consumers for higher fuel prices. Admittedly, the plan also calls for North-to-South transfers to address the negative distributive effects, but it fails to include a specific proposal on how to fund these transfers, how to allocate them, let alone an assessment of overall distributive effects. Third, te aforementioned extraction end dates would also result in an inefficient location of fossil fuel extraction (Coulomb et al. 2025), with e.g. cheap oil from Qatar being phased out 13 years before "dirty" oil from Venezuela.

An alternative policy would exhibit similar properties without the inefficiency problem: a producer carbon price. Under this policy, producer countries would price carbon at the wellhead and retain the revenue from carbon pricing (or most of them). Some argue that producer countries would accept a producer carbon price as a compromise if climate-ambitious countries were willing to penalise them for refusing to cooperate. To achieve this, climate-ambitious countries would need to commit to faster decarbonization and trade sanctions on fuel exporter countries (further reducing their revenues) if they fail to price carbon (Peszko et al. 2019). Compared to an equal per capita allocation of carbon price revenues, this solution lacks equity as it grants tax revenues to producer countries, most of which are wealthy. Furthermore, proponents acknowledge that the proposal hinges on fuel-importing countries' ability to credibly commit to unilaterally stabilizing the climate to compensate for producers' inaction; in reality, fossil-fuel exporters may doubt that importing countries are willing to make such sacrifices.

Table 2: Description of possible international policies to phase out fossil fuels.

International policy	Description
(*Status quo*) Unregulated ITMOs	Countries trade Internationally Transferred Mitigation Outcomes, bringing flexibility to the location of NDCs' emission reductions.
Partial linkage of carbon markets (Jaffe et al. 2010)	Carbon markets such as the EU ETS would accept external ETS allowance or emission reduction certificates up to some limit.
ITMOs + country-level integrity (Michaelowa et al. 2019)	ITMOs with extra rules preventing countries lacking ambition to participate.
ITMOs avoiding ambition gap	ITMOs with extra rules (described in Section 3.4) ensuring that countries trading ITMOs have joint NDCs in line with the Paris target.
(*Status quo*) JETPs (Ha-Duong & Cassen 2023)	Just Energy Transition Partnerships where one developing country obtains concessional loans from a set of HICs to decarbonize its power sector.
JETPs with more grants (Bolton et al. 2025)	JETPs financed by grants more than loans, of $120 billion per year.
JETPs with wider scope (Steckel et al. 2017)	JETPs with grants conditional on implementation of climate policy such as national carbon pricing.
Differentiated price floors (Parry et al. 2021)	Coordinated carbon price floors ($25/tCO$_2$ for LICs and lower-MICs, $50 for upper-MICs, $75 for HICs), with little revenue sharing between countries.
Carbon price on CBAM sectors (Wolfram et al. 2025)	International carbon price on carbon-intensive manufacturing sectors, with little revenue sharing between countries, either uniform price or differentiated price floors.
Climate club (Cramton et al. 2015; Nordhaus 2015; Weitzman 2017); Refunding club (Finus 2024; Gersbach et al. 2021)	Uniform carbon price, with little revenue sharing between countries, with a CBAM, and dissuasive tariffs on imports from outside the club. Refunding clubs add initial payments and performance-based refunds to incentivize compliance.
Carbon price incentive (Stoft 2009)	Countries of a coalition receive (pay) transfers to the extent they price carbon above (below) a benchmark and emit less (more) than global average.
Fossil-Free Union (FFU) (Fabre 2025)	International cap-and-trade, with revenue returned on a basis given by an equal per capita benchmark with some adjustments.
FFU + Sustainable Union (SU) (Fabre 2025)	International cap-and-trade and new taxes (especially on wealth), where international transfers are proportional to the difference between a country's GNI per capita to the world average.
Uniform price floor + SU	Sustainable Union with a uniform carbon tax rather than a cap-and-trade.
Fossil non-proliferation treaty (Calverley & Anderson 2022; Newell & Simms 2020)	Coordinated phase out of fossil fuel extraction, with supply cuts starting in richest countries and ending with poorer, more fossil-dependent ones.
Producer carbon tax (Peszko et al. 2019)	Uniform carbon tax applied on extraction or imports of fossil fuels, with part of the revenue shared with LICs and tariffs.
Expansion of climate finance (Bridgetown Initiative 2025; Dafermos 2025; Green Climate Fund 2021; Hourcade et al. 2025; Mazzucato & Songwe 2024; Songwe et al. 2024)	Reforms to the financial system to orient investment towards sustainable projects in the Global South, through public multilateral guarantees on climate projects, expansion of Multilateral Development Banks' (MDBs) operations, rechannelling of Special Drawing Rights to MDBs' capital, debt-for-climate swaps, money creation, etc.
Standards and bans	Implementation of common sectoral norms, e.g. standards on the CO_2-emission intensity of cars, shipping or aviation fuel; bans of fossil-fuel exploration, or on the opening of new coal power plants; common taxonomy for climate finance.

Table 3: Pros and cons of possible international policies.

International policy	Pros	Cons
(*Status quo*) Unregulated ITMOs	Cross-border financing of efficient decarbonization projects.	*Hot air*, risks weakening domestic climate action.
Partial linkage of carbon markets	Same as ITMOs.	Same as ITMOs.
ITMOs + country-level integrity	ITMOs with reduced hot air.	Either ambition gap or risks of unfair burden-sharing.
ITMOs avoiding ambition gap	ITMOs without ambition gap.	Trading between countries rather than firms, weakening enforcement.
(*Status quo*) JETPs	Cross-border financing of electricity decarbonization.	Limited scope; few grants; no effect on high emitting countries.
JETPs with more grants	JETPs with North–South transfers.	Limited scope; no effect on high emitting countries.
JETPs with wider scope	Potentially full country decarbonization.	No effect on high emitting countries.
Differentiated price floors	Country-wide efficiency; ambition adapted to country circumstances.	Few North–South transfer; no gains from trade.
Diff. prices on CBAM sectors	Decarbonization of manufacturing (efficient if uniform price).	Few North–South transfer (none if uniform price); limited scope.
Climate club; Refunding club	Efficient decarbonization.	Few North–South transfer; trade sanctions may fail to incentivize recalcitrant countries and will hurt the club.
Carbon price incentive	Incentivizes decarbonization; respects sovereignty.	Weak enforcement capacity; wealthy countries may receive transfers.
Fossil-Free Union (FFU)	Efficient decarbonization with North–South transfers.	Ambition and burden-sharing rigid to changing circumstances.
FFU + Sustainable Union (SU)	Efficient decarbonization with large North–South transfers, spurring development.	Climate ambition rigid to changing circumstances; imperfect incentives for countries to implement complementary climate policies (as international transfers don't depend on the country's emissions).
Uniform price floor + SU	Efficient decarbonization with large North–South transfers, spurring development.	Climate ambition not guaranteed (price may be too low); imperfect incentives for countries to implement complementary climate policies.
Fossil non-proliferation treaty	Decarbonization.	Relies on the (unlikely) participation of fossil-fuel producing countries; would increase oil rents and hurt consumers, especially low-income ones; lacks efficiency.
Producer carbon tax	Efficient decarbonization.	Relies on the (unlikely) participation of fossil-fuel producing countries; would increase oil rents and hurt consumers, especially low-income ones.
Expansion of climate finance	Lower interest rates in LMICs, spurring sustainable development.	Does not cap emissions.
Standards and bans	Decarbonizes one sector.	Limited scope; no North–South transfer.

Table 4: Comparison summary of possible international policies.

International policy	Emission reductions	Least cost	Fair		Acceptable by				Flexible
			Rich pay	Poor gain	LICs	MICs	HICs	Oil countries	
(*Status quo*) Unregulated ITMOs	0	+	0	0	+++	+++	+++	+++	+++
Partial linkage of carbon markets	0	+	0	0	+++	+++	+++	+++	+++
ITMOs + country-level integrity	+	+	+	+	+	+	++	++	+++
ITMOs avoiding ambition gap	+++	+++	++	++	+++	++	+	−−	-
(*Status quo*) JETPs	+	0	0	+	+++	+++	+++	+++	+++
JETPs with more grants	+	0	++	++	+++	++	+	−−	+++
JETPs covering broad policy	++	+	++	++	+++	++	+	−−	+++
Differentiated price floors	+	+	0	-	-	+	+++	-	+
Uniform price on CBAM sectors	++	++	0	−−	-	+	+++	−−	+
Diff. prices on CBAM sectors	+	+	+	-	0	++	++	−−	+
Climate club; Refunding club	+++	+++	0	-	+	+	+++	−−−	+
Carbon price incentive	++	++	+	+	++	+	+	−	++
Fossil-Free Union (FFU)	++++	+++	++	++	+++	++	+	−−	−−
FFU + Sustainable Union (SU)	++++	+++	+++	+++	+++	++	0	−−−	−−
Uniform price floor + SU	++	++	+++	+++	+++	+++	0	−−	+
Fossil non-proliferation treaty	+	-	-	-	-	-	-	-	+
Producer carbon tax	++	++	−−	−−−	−−−	−−	-	-	+
Expansion of climate finance	++	+	+	+	+++	+++	++	+	+++
Standards and bans	++	0	0	0	+	+	++	+	0

5 Conclusion

This paper presented a broad overview of the international climate policy regime and examined mechanisms through which climate ambition could be strengthened. I first demonstrated that the current regime fails to guarantee decarbonization in line with the Paris temperature target, as the sum of NDC targets exceeds the required emissions level. In this context, ITMOs will remain under-priced, and their unfettered use risks weakening overall ambition.

Then, I explored different options to regulate ITMOs. By restricting the use of ITMOs based on the adequacy of the seller's NDC, existing proposals (by e.g. Michaelowa et al. 2019) would limit hot air, but ITMOs would remain under-priced. To fully restore ambition and fairness, I proposed that a coalition of the willing submit a joint NDC aligned with the Paris target, and commit to exchanging ITMOs only among coalition members. I also suggested intermediary steps, such as strengthening reporting requirements to harmonize NDCs and establishing the principle that no ITMO should be sold by a country failing to meet its own NDC.

Finally, I analyzed alternative proposals to ratchet up ambition, such as differentiated carbon price floors, a fossil fuel non-proliferation treaty, and a refunding club. Alternatives appeared to either lack efficiency, lack ambition, or lack political realism, with the exception of JETPs. If ambitiously expanded in terms of scope and funding, these ongoing initiatives could boost both mitigation and climate finance (Bolton & Kleinnijenhuis 2024; Bolton et al. 2025; Steckel et al. 2017).

The success of international climate policy will likely require both a tighter regulation of ITMOs and an expansion of JETPs. In both cases, a coalition of the willing seems the most viable option to reap the gains from the cooperation of ambitious countries.

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