

International trade in carbon offsets under the Paris Agreement – Can Latin America fulfill Europe’s climate targets?

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Abstract¹

Global warming is a threat to human wellbeing. The Paris Agreement from 2015 made each country pledge a reduction in greenhouse gas emissions and then opened for international trade in carbon offsets to induce cost efficiency. There are still few trades and the realised cost of climate policies differs a lot between nations. It is hence a puzzle why the countries do not exploit this potential for arbitrage. Demand is increasing by western nations to fulfill their 2030 pledges, but the article 6.2 framework is still not finalized in host developing countries institutions who hence not ready to supply carbon offsets. The study traces the ongoing institutional processes in Colombia and Peru to enter the \$6.2 market through qualitative research

¹ I am most thankful to Los Andes Business school and the Pontifical Catholic University of Peru (PUCP) for hosting me as guest researcher in 2025 and thereby facilitating interviews with relevant national actors for this study. I thank Jemima Garcia-Godos and Asbjørn Torvanger for useful comments and suggestions.

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1 Introduction

Global warming is a threat to our existence as we know it today. The overarching goal of the Paris Agreement (PA) is to hold “the increase in the global average temperature to well below 2°C above pre-industrial levels” and pursue efforts “to limit the temperature increase to 1.5°C above pre-industrial levels.”²

The main challenge has been to identify a politically acceptable climate regime that is both cost-efficient and limits free riding. Economists have long argued that all greenhouse gas emitters should face the same carbon price per ton of CO₂ equivalent (tCO₂e), regardless of sector or geography (Nordhaus, 1982; Pigou, 1920). Such one-price policy will be a cost-efficient way to achieve the climate target as the right to emit tCO₂ would be bought by entities with higher profits/utility, while entities with lower levels will simply cease to emit. However, such a policy has so far proven politically difficult to implement.

Instead, under the Paris Agreement the countries agreed to implement a second-best solution: national emission targets, a solution leading to huge cost differentials. A fine of just 5 USD/tCO₂e for road transport fuel in Colombia induced large rainforest protection projects, while additional reductions in Norway is estimated by the Norwegian Environment Agency to cost 150 USD/tCO₂e (NEA, 2025). This is not cost-efficient from a welfare-economic perspective as Norwegian taxpayers could contribute 30 times more to reduce global heating by paying for Colombian rainforest protection instead or achieve the same climate effect for 1/30 of the cost (Wiig and Torvanger, 2025).

Parties to the Paris Agreement decided to allow such trade based on arbitrage to increase economic efficiency at the Conference of the Parties (COP) in Glasgow 2021. Two countries can now engage in bilateral trade under PA §6.2 and unilateral trade under PA §6.4. Emission reductions sold under Article 6.2 must be deducted from the host country’s NDC before they can be counted toward the purchasing country’s NDC. In theory, with no transaction cost, this trade in carbon offsets denominated Internationally Transferred Mitigation Outcomes

² <https://unfccc.int/process-and-meetings/the-paris-agreement>

(ITMOs) in the PA methodology will lead to the identical world market price of the first best solution.

Cost-efficiency is important to curb global warming because it will become easier to pledge more ambitious NDCs. The current updated NDCs for will increase temperature to 2.3-2.5 degrees, while the current policies will lead to just below 3 degrees(UNEP, 2025).³

The PA countries are approaching their first 2030 milestone of pledged reductions. With less than four years to go most western countries are lagging behind, e.g. Norway has only reduced 14 percentage points of the pledged 55% reduction (NEA, 2025). Many politicians have simply assumed that ITMOs can be purchased as the solution of last resort to reach national goals. The Norwegian Ministry of Climate and Environment (KLD) started in 2019 to collaborate with Senegal, Zambia and some other developing countries to finance climate projects where Norway would buy the resulting ITMOs. However, Norwegian authorities now realize that the process will not be completed in time for them to actually use carbon offsets to meet their NDC targets by 2030.

There is so far only one successful transfer of ITMOs in the world. The Klik foundation of Switzerland had financed the Bangkok E-bus program in Thailand where the emission reductions were credited the Swiss NDC in 2024.⁴

This study investigates why it has taken so much time to develop bilateral trade agreements for carbon offsets and identifies slow processes and even resistance within host countries' bureaucracy to be the main explanation. Case studies of two countries with apparently opposite policies illustrate the institutional complexity of actually reaching an agreement between two countries.

This study is based on interview material with key informants from different ministries, academia, NGOs and politicians in Colombia and Peru in the period January to May 2025. Colombia had initiated to develop the necessary PA \$6.2 framework under the right-wing

³ Even 3 degrees might be an optimistic figure since USA and other countries repeal existing climate policies.

⁴ <https://www.klik.ch/en/news/news-article/new-itmo-issuances-for-ndc-use-from-bangkok-e-bus-programme/>

president Duque 2018-2022, but the incoming government of left-wing president Petro was more ideologically skeptical to carbon market solutions. The Colombian government realized its limited institutional capacity to really control private sector certification of carbon offsets. Furthermore, it preferred forest protection and other climate projects with direct implementation by local communities to build and strengthen the state's relationship with the citizens.

The Peruvian government has on the other side seemingly embraced the possibility to produce and export carbon offsets under the Paris agreement. Switzerland contacted the country as early as 2015, started formal negotiations in 2018, signed an implementation agreement in 2020 and developed it into a bilateral agreement in 2022, just after COP26 in Glasgow in 2021 formalized and regulated \$6.2 bilateral trade. The Klik foundation financed the construction of 30.000 clean burning kitchen stoves in these years but has so far not been able to convert these climate projects into transferable ITMOs. Peru passed the first hurdle of completing a digital registry of ITMOs to avoid double counting of GHG emission reductions in 2025, but the different ministries have still not agreed on what types of projects will be accepted and how to measure the GHG emission reductions to produce ITMO. The Peruvian Ministry of the Environment responsible for the process lacks the institutional strength to challenge the larger and more powerful Ministry of Finance, Ministry of Energy and Mines to finalize the process. Part of the reason is that the payment for ITMOs is not perceived to be important as mining taxation already exceeds the Peruvian governments institutional capacity to spend on public projects.

Switzerland is still waiting for the first transfer of ITMOs to take place 10 years after they optimistically started the process. International carbon offset markets is an arena for social and institutional innovation. However, the hope is that once Peru has been able to finalize the \$6.2 project will the Ministries have the knowhow and experience to pass a large number of different projects in a short time, e.g. wastewater treatment facilities in Lima with Switzerland or rainforest protection with Singapore with whom they signed a new bilateral agreement in 2025.

2 Theory and background

2.1 One price vs. pledged volumes

One price/tax for emissions in all countries as recommended by economists would allocate GHG emissions to the economically most valuable industries and consumers with highest willingness to pay at global level. This is a cost-efficient solution as it is not possible to increase economic welfare through arbitrage⁵ and thereby defined as the first-best policy in economics provided that there are no transaction costs.

However, a serious political attempt to implement such global price for GHG emission policy is yet to be seen, for several reasons. Most countries in the Global South⁶ lack the institutional capability to monitor emissions and implement a system for payment for emissions (Gault, 2021). Furthermore, the past aggregated emissions in the rich industrialized countries are much higher than the for the so far unindustrialized poor countries. The rich countries are hence to blame for global warming and have a «carbon debt» to the poor countries (Torvanger, 2023). It is thus perceived as unfair if poor countries are prevented from industrialization due to high GHG costs that early industrializers never paid. There is furthermore a moral sentiment that each country should contribute by reducing their “fair” share of the GHG emissions. Rich countries should simply not be allowed to continue the destruction of our planet through paying the poor countries to reduce emissions. Payment for emission reductions is perceived as indulgence and the exploitation of other nations’ poverty.

Climate concerned nations have hence sought second-best policies as the first-best policy since one world price is politically not viable. The signing of the United Nations Framework Convention on Climate Change (UNFCCC) Paris Agreement from 2015 by 195 nations is

⁵ Arbitrage would mean to sell the right to emit from a country where the value of the emission is low to a country where it is high, whereby the two parties can split the total improvement and hence increase economic welfare.

⁶ I will use the terms Global South vs Global North when it comes to institutions and poor and rich countries when it comes to economic potential.

hence hailed as a major breakthrough to achieve a coordinated effort to stop global warming. Countries are free to define their own domestic emission reduction targets denominated Nationally Determined Contributions (NDC) and the countries are also free to choose what climate policies to implement. More importantly, the UNFCCC cannot sanction non-compliance. However, peer-pressure from other nations is expected to strengthen new NDCs rather than not fulfilling existing NDCs.

The NDC framework implies that each nation will set a numerical number for GHG emissions allowed in each country which means that the cost of reducing the last unit will differ enormously between nations. This is clearly not a world welfare optimum as climate policies will then not be implemented according to cost worldwide, i.e. least expensive first and then progressively more expensive, and is hence a second-best solution.

2.2 International trade induces static cost-effectiveness

This economic inefficiency of national emission quotas can be corrected through international trade in carbon offsets. A high-cost country will then purchase reduction from low-cost countries and thereby be able to emit more than allowed by the pledged NDC within its geographical borders, and vice versa for the selling host country of the climate project. The cost of emission reductions will increase in the latter and decrease in the former until all arbitrage possibilities are exhausted as the cost is identical in both countries. Theoretically, disregarding transaction cost, the price will then equal the world price discussed in the former subsection. The outcome of a quota system will then be identical to the outcome of the one-world price policy discussed in the former subsection and also be cost efficient.

The decision to implement PA §6.2 on international trade in GHG emission reductions under the 26th Conference of the Parties (COP) in Glasgow in 2022 was hence considered to be a great breakthrough to increase economic efficiency in the fight against global warming. Rich countries can finance projects in poor countries, where the emission reduction will count in

the rich country's NDC rather than the poor's.⁷ The two countries can negotiate how to split the value added by the transaction and both parties can improve both their economic and emission mitigation outcome.

2.3 Externalities and dynamic effects

The static analysis above does not include the possible benefit of externalities in the implementation of climate policies. A high price on emissions reductions in rich countries will tempt/force actors to innovate and improve technologies to become more carbon efficient⁸ to reduce the, to reduce the total expenditure on rights to emit in industrial processes, transport and consumption. Over time, the innovation will reduce the cost of low-emission technology and thereby make climate-friendly solutions more affordable even for poor countries. Solar panels with batteries have become more cost-efficient than fossil energy solutions in the African countryside. There is hence an argument to prevent trade by keeping abatement costs high and thereby give an incentive for innovation, implying that the static first-best solution of one world price or tradable carbon offsets are sub-optimal to dynamic policies.

2.4 Alternative innovation

The alternative to facilitating innovation through high abatement costs resulting from a quota regime is to finance climate research and development from the economic surplus stemming from international trade.

The high marginal abatement cost is normally due to ambitious reduction targets that require immediate roll-out of semi-developed green technologies. Innovation is then more of a biproduct of learning-by-doing to fulfill short term targets than research and development

⁷ The host country will define a set of climate policies and projects to comply with their NDC and thereby define what climate policies and projects they will not be conducted. Other countries can finance the latter and transfers the emission reduction to the purchasers NDC without reducing the host countries possibilities to fulfill its NDC.

⁸ Production value per unit of carbon emitted

through purposeful development of many different variants combined with testing and large-scale piloting to identify the best way forward.

The current roll-out to fulfill national quotas within their own country is financed by high energy prices in combination with state subsidies. The alternative of one global price for emissions or international trade in emissions will lead to more reductions in poor countries and less in rich countries. However, the governments can implement energy taxes equal to the reduced costs in rich countries and finance a massive purposeful development of green technologies. Investing this money in research and piloting into a wide set of green technologies has a larger potential to solve the climate challenge eventually at the same time as the world can use trade to fulfill intermediate emission targets (Acemoglu et al., 2012).

The world temperature is rising faster than we believed and there is a real risk of passing tipping points with reinforcing mechanisms like desertification and melting of permafrost that release GHG into the atmosphere. Another alternative is to finance additional and traditional climate projects in poor countries that will reduce the global warming process within brief time.

The current EU climate policy of targeting 55% reductions in European emissions within 2030 is an illustrative example. Interventions to reduce emissions in Norway now costs about 150 USD/tCO₂e (NEA, 2025). Colombia set a 5 USD/tCO₂e tax on emission from road transport fuels. However, they were exempted from this tax if they could prove reductions in other climate projects. This lead companies to finance a large number of REDD+ forest projects which demonstrates the low lost cost GHG emission reductions in many developing countries (Wiig, 2025). The cost of reducing emissions in Colombia is hence only 1/30 of the cost in Norway. This illustrates how we can either scale up purposeful research and development thirty times or reduce thirty times more emissions than today by designing and implementing an efficient system of international trade in emission reductions under Paris Agreement §6. A combination would probably be the preferred choice by climate conscious voters, but we must also expect that other voters will prefer to spend their savings elsewhere.

An additional element is that politicians, bureaucrats, and other policy makers of today are stressed by the 2030 target for which they will be held responsible. This inevitably leads to less willingness to finance and thereby postpone «long-term climate solution» projects by developing new green technologies that approach a net zero emission society in 2050⁹, for which as they will not be accountable for. Short term targets can hence be detrimental to achieving long term end goals rather than steppingstones to get to a climate friendly planet.

3 Challenges to trade in carbon offsets

3.1 Introduction

The Paris Agreement 2015 is the current worldwide attempt to coordinate emission reductions. It mostly sets emissions targets within national borders for all participating countries, the so-called National Determined Contributions (NDC). The Paris Agreement §6 opens for international trade in achieved emissions reductions between countries. A country with high abatement costs can hence purchase reduction from countries with low abatement costs given that the seller still achieves their emission reduction target. Emission reduction hence becomes a “product” that can be traded.

However, many types of emission sources are exempted from the NDC. International transport is difficult to quantify within specific national territories. The Paris Agreement hence delegated the negotiations and formulation of rules to sector specific UN organizations also because the solutions might be more technical in nature. Other emission sources are still exempted due to political dilemmas, e.g. the military. This section will present the different climate agreements and institutional arrangements that seek to limit GHG emission in the world.

⁹ Most developed nations have stated a net zero by 2050 target, while some developing nations has postponed this target, e.g. China in 2060 and India.

3.2 Paris Agreement for NDC

3.2.1 From national to international solution

The United Nations Framework Convention for Climate Change (UNFCCC) is an international treaty that constitutes the process to negotiate international climate policies between countries under the UN. The signatory countries are denominated «Parties» and meet regularly to develop this institutional framework. At the 21st Conference of the Parties (COP) in Paris in 2015, the 179 signatory countries agreed to set GHG emission reduction targets to be reached by 2030 for all of them, industrialized as well as developing countries, denominated The Paris Agreement (PA).

This new climate agreement had a quite different approach compared to the preceding international climate agreement from 1997 denominated The Kyoto Protocol. In the latter, 37 industrialized countries negotiated a set of individual targets to be enforced “top-down” exempting developing nations. The Paris agreement is on the contrary a bottom-up approach. Each country is free to set their own NDC but will still feel the pressure or inspiration from other nations to set ambitious goals. The outcome will induce a stronger institutional and political ownership in each country to their declared NDCs and thereby perform better than the top-down decisions system where targets are imposed upon them.¹⁰

3.2.2 International bilateral trade in §6.2

The bilateral trade between a pair of nations, one seller and one buyer of emission reductions, is regulated in §6.2 of the Paris Agreement.¹¹ The main components of the UNFCCC rulebook for bilateral trade were agreed in COP26 in Glasgow in 2021. It gives considerable freedom for the two parties to agree what types of projects that can be included, methodologies (effect measurement) and organization of the process if they fulfill the reporting requirement to the UNFCCC.

¹⁰ Indirect emission from consumption of products and inputs in production are not included to avoid double counting.

¹¹ Decision2/CMA.3, i.e. de second decision of “The Conference of the Parties serving as the meeting of the Parties to the Paris Agreement (CMA)” that was adopted at their third meeting.

The sequence is as follows: The two parties first agree on the organization of the process. Then they agree on type of project to be included (positive list) or excluded (negative list) and then issue a call for proposals in which both private and public entities can apply. The rulebook requires that trade does not lead to double counting, i.e. that the same emission reduction is included in both the buying and selling countries' NDC. The country pair must hence agree on how to make the corresponding adjustment, i.e. first measure the effect of the agreed project and then deduct this amount from the NDC of the selling country.¹² There is no need for UNFCCC to control the measurement since both parties must agree on the achieved emission reduction outcome. What is added to the NDC for one country, is deducted from the NDC of the other. The net effect of the transaction is hence zero and the execution and reporting can be left to the parties without interference from UNFCCC. As of today, there is only one project that has been able to complete the PA§6.2 process of actually passing ITMOs from the host country to the purchasing country.¹³

3.2.3 International singular trade in §6.4

Bilateral trade requires much coordination between the two countries and furthermore also requires considerable coordination between institutions within a participating country. The UNFCCC is now formulating specific requirements and certification of emission reductions that can later be purchased from any country without active participation in the «production» process. This is referred to as international singular trade and is regulated by §6.4.

The country in which the §6.4 certified emission reduction is produced can then sell it to any willing buyer in a sort of auction mechanism denominated the Paris Agreement Crediting

¹² An agricultural project might for example by default be part of an overall territorial measurement by based on satellite images, while the emission reductions on a specific farm might be part of the traded project. By measuring the effect of the project, the selling country knows how much to deduct from their overall satellite image measurements.

¹³ Klik, the climate foundation that acts on behalf of the Swizz transport fuel distributors that must meet emission requirement set by their government, finances part of a Thai bus company's investment cost for new electric buses in exchange for certified mission reductions. The transaction requires the active involvement by both countries' governments.

Mechanism (PACM) and the mechanism perceived to be «UN’s new high-integrity carbon crediting mechanism»¹⁴

While the fundamental rules, modalities and procedures were decided at COP26, more specific regulations have been developed by decisions in later COPs and §6.4 is still not operational. The UNFCCC parties are not able to agree on which certifications systems will be accepted, a vital element since such third-party entities will then be the only agent to control the reliability of the project claims.

3.2.4 Support to build national institutions §6.8

The Paris Agreement also requires rich countries to support poor countries in achieving their NDCs. The COP29 in Baku 2024 decided that rich countries should transfer 300 billion USD per year within 2035.¹⁵ Most poor countries have split their NDC target into two sub-targets, one unconditional to external financing and one conditional of such financing from abroad. The previous Peruvian NDC set the unconditional target for emissions in 2030 at 209 million tons carbon dioxide equivalents (MtCO₂e) with further reductions to 179 MtCO₂e conditional on receiving financial support from abroad. The updated NDC has only set an unconditional target for 2035 to maximum 179 MtCO₂e emissions and not include any conditional target on foreign financial support at all (GoP, 2025).

However, it is important to notice that the financial support for institutional development under §6.8 does not bring any emission reductions to the financing rich country. There is hence no incentive for the donating country aside from the aim of contributing to the world’s common good. The guidelines rather indicate how the donor can assist in building institutional and technical capacity in the receiving country to reduce emissions. One of the main roles in paragraph §6.8 is matchmaking. UNFCCC has built a database where projects

¹⁴ <https://unfccc.int/process-and-meetings/the-paris-agreement/article-64-mechanism>

¹⁵ <https://unfccc.int/news/cop29-un-climate-conference-agrees-to-triple-finance-to-developing-countries-protecting-lives-and>

in developing countries are presented to donors looking for such initiatives to be financed, denominated the Non-Market Approaches (NMA) Platform.¹⁶

3.3 International aviation

The International Civil Aviation Organization (ICAO) is a United Nations agency where the 193 member countries cooperate on organizing the use of airspace. UNFCCC delegated the authority to reduce GHG emissions in international air transport between countries in 2016¹⁷. The countries agreed to Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) to reduce future annual total emissions from the sector to maximum 85% of the emission level in 2019. The practice will be developed over three periods. The Voluntary pilot period (2021-23) and what is denominated the First phase (2024-26) were still voluntary, and large developing nations like Brazil, China and India did not join. The Second phase (2027-2035) will be complementary for all ICAO member nations except for landlocked countries and (smaller) nations with less than 0,5% of total world emissions. CORSIA will hence cover an estimated 80% of international passenger and freight aviation related emissions worldwide.

ICAO calculates a baseline growth in air traffic and imposes a corresponding net reduction in emissions for each flight. The airlines can achieve this aim through (i) less use of fuel, for example due to more efficient engines, (ii) less emissions per unit of fuel or (iii) carbon offsets from unrelated projects reducing emissions in other parts of the economy or nature.

This, and similar national requirements for example in the EU, have improved the fuel efficiency in aircraft considerably but the technology is expected to improve at a slower pace in the future. Sustainable aviation fuel (SAF) from either biological source – with limited resources - or processing of electricity (eFuels) is rather expensive. CORSIA does not differentiate between sources of emission reductions and the airlines are hence expected to

¹⁶ <https://unfccc.int/process-and-meetings/the-paris-agreement/cooperative-implementation/Article-6-8/nma-platform/main/non-market-approaches>

¹⁷ <https://aviationbenefits.org/environmental-efficiency/climate-action/market-based-measures/corsia/corsia-explained/>

buy carbon offsets that are costs less per unit of emission reduction than reducing their own emissions.

3.4 International maritime transport

International Maritime Organization (IMO) is a UN Agency with the mandate to reduce GHG emissions from international maritime transport, which is also not included in the NDCs under the Paris agreement. The 173 member states reached a preliminary agreement called Net Zero Framework (NZF) on climate technology and set a 320 USD/tCO₂e fine for not fulfilling the GHG emission requirements in April 2025. Carbon offsets through international trade were supposed to be a cornerstone in the agreement to achieve economically efficient abatements.

However, the new US government later fought this climate regulation and was able to mobilize sufficient votes to postpone its final decision for a year at the IMO meeting 6 months later.¹⁸ Most observers believe that that IMO will not set NZF or any other climate regulation up for voting before there is a fundamentally new approach to climate regulations by US government.¹⁹

3.5 The market for carbon offsets

3.5.1 Demand

Based on the above, an increasing demand for carbon offsets can be expected in the future as they will qualify as emission reductions under PA\$6.2, PA\$6.4, ICAO CORSIA and probably the future IMO-NZF. These agreements impose few restrictions on how and where they can be produced. This makes them politically more palatable also for developing countries that,

¹⁸ Financial times: Trump campaign to block global shipping emissions deal falters, 15. October 2025

<https://www.ft.com/content/0e6f2515-fcb0-448a-b43f-e6f2343bc6c2>

¹⁹ USA still treats to impose sanctions, port fees and visa refusals against member states voting to adopt the IMO net-zero framework and USA furthermore refutes regional climate policies like EU ETS for shipping,

<https://www.spglobal.com/market-intelligence/en/news-insights/research/2026/02/no-clear-path-imos-net-zero-framework>

for example, perceive to have a comparative advantage in agriculture and thereby biofuels also based on palm oil, which EU and other developed regions try to avoid.

The increasing popular critique of expensive climate projects in developing countries has become difficult for politicians to ignore. The new Norwegian NDC set a 70-75% emission reduction compared to 1990 emission level target for 2035 (GoN, 2025). However, in contrast to the former NDC where all reductions would take place within own borders, it now opens for the use of carbon offsets from poor nations and there is no explicit requirement for domestic reductions. This 180-degree political turn-around was probably necessary to have any chance fulfilling the 2030 target since the country had only achieved 9 percentage points out of 55 percent pledge by 2025 (GoN, 2025).

A similar political turn-around that is taking place in the EU. Their 55% NDC target for 2030 must be reached by emission reductions within EU Emission Trading System (ETS) sectors and within nations for non-ETS sectors. However, the EU now discusses whether they shall open for carbon offsets in their 90% NDC target for 2040.²⁰ They might demand that a certain share of the reduction must take place in Europe, and thereby also committing Norway as an EEA²¹ member to the same limitation.

EU and some other nations skepticism of biofuels is another element that increases demand for carbon offsets. EU directives limit the use of crop-based biofuels to maximum 7 percent and explicitly forbids palm oil-based biofuels in aviation and maritime sector.²² Both elements increase the price of using biofuels to reduce emissions as the alternative to carbon offsets.

3.5.2 Supply

The current supply of offsets certified to comply with the UN regulations is currently rather restricted. The main reason is a lack of projects due to the collapsing confidence in the

²⁰ <https://www.politico.eu/article/eu-exploring-weaker-2040-climate-goal-90-greenhouse-gas-cut-wopke-hoekstra/>

²¹ European Economic Area (EEA), an agreement between EU on one side and Iceland, Lichtenstein and Norway on free markets that require harmonization of the carbon market.

²² EU Renewable Energy Directive, ReFuelEU Aviation Directive, ReFuelEU Maritime Directive.

validity of the carbon offsets with tumbling prices on the voluntary market. Different forms of fraud and reports of misbehavior towards local and indigenous populations led to bad publicity and accusations of «green washing» rather than the intended good publicity for the buying companies that aim to become carbon neutral. Carbon offset prices on the voluntary market well below 5 USD/tCO₂ make new projects unprofitable.

The compliance markets like the NDCs of the Paris agreement and ICAO-CORSIA and IMO-NZF will behave differently. There is an intention to impose heavy fines on non-compliance with emission regulations when they are enacted, e.g. the proposed IMO-NZF 320 USD/tCO₂e fine. A company's willingness to pay will increase to the level of the fine and they will probably be less concerned about possible public reactions to the origin and type of technology applied, e.g. tanking biofuel from palm oil if this is accepted by the regulator, with less concern for the public image.

Norway's has only reduced emissions by 14% so far, while EU is more successful with 37%.²³ However, cheap measures like substituting coal with natural gas in electricity production in EU explains the difference from the hydroelectricity supplied Norway. EU too will have a tough time to achieve their NDC as low hanging fruits are becoming exhausted. Companies weigh the expected future fines against the cost of implementing new green technologies to reduce emissions. UNFCCC cannot penalize NDC noncompliance and ICAO and IMO will probably lack disciplining capacity if important countries like USA disagree to the rules.

It follows that also nations might become less strict on national regulations of industries and consumers. Germany, for example, issues a fine of 600 euro/tCO₂e of non-compliance in the road transport sector, which in periods has led to a similar increase of the carbon premium of biofuels.²⁴ However, such heavy-handed national climate policies are probably not politically sustainable if few other nations impose similar stringent penalties. Sweden chose to cancel a biofuel policy when the price increase caused popular resistance. It will

²³ <https://www.europarl.europa.eu/topics/en/article/20180706STO07407/what-progress-has-the-eu-made-against-climate-change-infographics>

²⁴ Personal communication with biofuel traders. The fine led to imports of biofuels with high emission reductions and exports of low emission product.

probably grow stronger if the cost of climate measures reduces the competitiveness of national companies.

The companies' expectations of future fulfillment obligations might become a self-fulfilling prophecy. If they expect hard sanctions and fines, both companies and governments will invest sufficiently now to reach the targets tomorrow. If not, there is no reason to invest and the emission reduction targets will not be reached.

The ICAO-CORSIA and IMO-NZF have set stricter rules for non-compliance in the international aviation and maritime sector in contrast to the Paris Agreement's lack thereof. Airplanes and ships that do not comply with the rules set by these international organizations risk losing their license to operate and thereby cause inactivity. It is questionable whether these organizations have the strength or willingness to impose such strong sanctions if the member countries do not meet their NDC targets.²⁵

3.5.3 Market equilibrium

There has been a popular perception that the demand, rather than supply, will be the limiting factor for production of ITMOs rather than supply. The potential to reduce carbon emissions or remove carbon through low-cost technologies is large in developing countries, e.g. forest protection, wastewater treatment, tree planting, etc. Increased demand for carbon offsets from compliance markets is expected to increase the price and thereby spur the development of new certified carbon projects.

Future carbon offset prices are highly uncertain and depend on the underlying assumptions of the simulation model.²⁶ The current 73 euros for ETS emission rights within Europe is one alternative cost and hence a price ceiling for offsets at least for European countries. However, lower prices will be the partial effect of opening for international trade. On the

²⁵ President Trump withdrew USA from the Paris Agreement and is now lifting the climate regulation of their coal industry. There is hence no reason to believe USA will force their companies to comply with ICAO and IMO climate regulations and the organizations will probably not be able to refuse their airplanes and ships to operate internationally.

²⁶ Equilibrium model simulation of market supply and demand for CORSIA eligible carbon offsets indicate USD 18-51 range per tCO₂e during phase I and USD 27-91 during the latter stages of Phase II, <https://www.msci.com/www/research-report/corsia-costs-and-implications/05133019267>

other hand, stronger climate targets will increase demand and thereby increase the price. Furthermore, emission reduction costs and climate targeting are related under the Paris Agreement. The countries are expected to increase their NDC pledges as the costs of green energy and climate solutions come down over time. With cheap emission reduction purchased on the international market, especially developed countries can increase the NDC target for the same total cost.

4 Differentiated approaches in Peru and Colombia

4.1 To embrace or mistrust export and carbon offset trade

Countries in the South are often poor because they are not involved in international trade. The initial export led growth of low technology industrialized goods technologies of South Korea and Taiwan facilitated development and improved living standards. Today, rich countries are willing to pay poor countries to reduce GHG emissions directly or export goods with low carbon footprints. And whatever people are willing to pay for is a product, hence a *climate product*, whether the carbon reduction effect is a characteristic of another “green” product or service or a standalone product like carbon offsets. Such carbon products can be both the absolute and comparative advantage of many countries in the South, and hence their potential escape from poverty through international trade.

There is a potential for cheap sustainable green energies in regions with low population density in Latin America and Africa. Some examples are wind power on the La Guajira desert peninsula into the Caribbean Sea in Colombia, solar power in the Atacama Desert in Chile and biofuels from the agricultural sector in Colombia and Brazil. Both countries mandates biofuels in transport fuels and still have more land available to produce for exports. The Altillanura savannah in Colombia has 5-7 million hectares of unused agricultural land available for palm oil. The resulting biofuel reduces end use emission by -134% since palm increases biomass compared to the current natural grasslands and there is no deforestation (Gmünder et al., 2018). A reasonable premium for the beneficial climate effect will increase the payment for their palm oil with 50-100% and a full-fledged specialization on this huge

area has the potential to increase Colombian GDP by 10 percent.²⁷ These, or transformed energies like hydrogen, can be exported competitively with other green energy resources in the world.²⁸

Reductions of greenhouse gas (GHG) emissions is a commodity like any other commodity under PA\$6.2, PA\$6.4, ICAO-CORSIA and IMO-Strategy. These regulations do not differentiate between sources of the GHG emission reduction which implies that the compliant responsible party would be willing to pay the same price for each ton of emission reduction independent of geographical and sectoral origin. The current cost of climate projects in Norway today is about 150 euro/tCO₂e (NEA, 2025). Colombia offered to cancel a 5 USD/tCO₂ tax exemption for road transport fuel companies that could produce carbon offsets instead, with a total estimated effect of 120 million tCO₂e reductions from 2018 to 2025²⁹. The population in many rainforest areas is heavily dependent on income from illegal activities like alluvial gold mining, timber and coca production. The production of certified carbon offsets for export through protecting the forest from the activities in REDD+ projects is an alternative use of the same areas.

Several developing countries are skeptical about starting emission trading both within their own country as well as exports to other countries. This skepticism also applies to regulations on measured emission levels in general. The governments fear it will become impossible to measure the outcome in a credible way, and such markets are furthermore open for corrupt practices. A regulation system based on the measurement of emission outcomes might simply be too complicated for the existing institutional capacity and power relations in developing countries to become a target fulfilling policy. Countries like India hence prefers to regulate sectors to require tangible observable inputs and investments, e.g. subsidies for

²⁷ My own calculations based on detailed information from a biofuel project in Colombia and information from biofuel traders.

²⁸ The current left wing president Petro has stopped further exploration for gas and oil out of an overall concern for climate with detrimental effects on the Colombian economy. The country is hence in dire needs for new industries to compensate for this loss.

²⁹ <https://www.argusmedia.com/zh/news-and-insights/latest-market-news/2682766-colombia-s-co2-tax-collections-to-surpass-2024>

the purchase of technologies that are expected to reduce emissions like biofuel refineries to process agricultural residuals.

The ideologies and perceptions of what constitutes a just society furthermore differ between nations and thereby their preference for a market solution vs. state-initiated project development approaches. To illustrate this situation, two cases are presented in this article: Colombia, with a left-wing president known to resist market solutions and Peru, which has embraced market liberal solutions for the past 35 years ago. The former refuted \$6.2 bilateral agreements, while the latter is a pioneer in all sorts of private public partnerships (PPP) between government and private entities. However, ideologies matter less as institutional weakness is the reason why none of them has so far been able to complete the PA\$6.2 process that would allow the sale ITMOs.

4.2 Peru - No finalization despite early start

4.2.1 Market liberal champion

President Alberto Fujimori came to power in 1990 and started immediately to deregulate the central planning economy of predecessor president Alan García which had caused hyperinflation and economic depression. The free market and minimization of state responsibilities have ever since been a characteristic of Peruvian economic policy despite considerable political turmoil leading to shifts in presidents and ministers. While politicians come and go, a successful private sector mostly driven by the mining sector led to high growth rates over several decades.

The non-interventionist governance approach favored Private Public Partnerships (PPP) to execute and own public infrastructure is financed by high mining tax incomes as the world price of minerals surged. A minimized and furthermore discredited state apparatus lacked employees to conduct the necessary tasks and was hence supplemented by donor-financed experts and bureaucrats. The ministries would prioritize tasks financed from abroad rather than execute the will of the government. The government was filled with technocrats and

lacked a clear political vision to lead the ministries. Both issues gave donors considerable influence on policies and program choice as well as execution.

4.2.2 Embracing carbon offset trading

Former employees in the Ministry of the Environment interviewed for this research indicate that they worked considerably on the World Bank's Partnership for Market Readiness (PMR) to build the countries' capacity to identify, design, develop, and implement carbon pricing instruments (CPIs), along with relevant policies, laws, and regulations after it was established in 2011.

The organization both knew the issues and had prepared procedures for carbon offset trading when COP21 indicated that bilateral trade to fulfill NDCs would be allowed under the Paris agreement. The Swiss government contacted their Peruvian counterparts to develop a pilot that might be filed as such a project once the Parties opened for and set the rules for such collaboration. The two countries signed an implementing agreement in 2020 after two years of negotiations; this was presented as the «world's first PA §6 deal». In reality it should rather be considered as a pilot or letter of intent, given that the PA§6 regulations were still not decided at that time.³⁰ However, this pilot was immediately transformed to a bilateral §6.2 agreement in 2022 once COP26 in Glasgow opened for international trade in emission reductions.

However, the specificities of the agreement were still to be defined. Especially the PA §6.2 required a well-functioning registry of carbon certificates for transparency to prevent double counting, e.g. same reduction filed on both seller and purchasing nations' NDC. Furthermore, it introduced a methodology to secure corresponding adjustments, e.g. sold project offsets must be deducted from the national NDC. There is a mismatch in methodology between the measurement of GHG emission reductions at macro (national or regional) through satellite photos by national authorities and micro (project) level that is measured by the project developers and their appointed verifiers. There is thus a risk that a

³⁰ <https://www.climatechangenews.com/2020/10/21/peru-switzerland-sign-world-first-carbon-offset-deal-paris-agreement/>

reduction is counted twice, i.e. both in the host country NDC and in the purchasing country NDC. UNFCCC, hence, requires a digital registry system for ITMOs to secure that the exported emission reductions are deducted from the host country's NDC.

Switzerland took the initiative to speed up the process. Based on informal discussions with the Ministry of the Environment, they concluded that clean burning rural kitchen stoves would be convenient for initial projects. Such projects fulfilled several aspects the Swiss considered to be important. They required "financial additionality", e.g. not economically viable without the payment for the resulting emission reductions, even though it is not required by the PA §6.2. They furthermore exempted REDD+ projects protecting forest considering them not to fulfill the PA §6.2 «durable effect» requirement. Increase in biomass might later turn into emissions due to forest fires or logging. The environmental ministries in the two countries also concluded that such stoves would pass the PA§6.2 requirement of «additionality», which in this context means that international financing with transfer of ITMOs does not reduce the selling country's ability to fulfill their own NDC.

The commercial counterpart Klik that needs the ITMOs to fulfill their emission reduction obligations towards the Swiss state issued a tender for building and installing such stoves in the Peruvian highlands in 2022. A French NGO won the competition and had by now installed 30.000 such clean burning stoves in three departments of Northern Peru financed by Klik.³¹

Klik was willing to take the risk of investing in the production of carbon emissions reduction before the two governments had agreed on all details in their bilateral §6.2 mechanism. True to the project's pilot origin, they expected that the process would turn out well in the end.

The additionality requirement set by the Swiss government, however, turned out to be a possible stumbling stone for the certification and final transfer of ITMOs. The Peruvian government had later set up a positive list of 66 types of projects that the country should do themselves to fulfill their own NDC. Klik would have avoided any competition by choosing projects exempted on the list. In the meantime, the governments ended up including the clean burning kitchen stoves in the list and thereby created doubts about whether the Klik's

³¹ Lambayeque, Cajamarca and La Libertad,

kitchen stove projects would be accepted as “additional”. The basic reasoning for rewarding ITMOs for projects that otherwise would not have taken place can still be satisfied. There are millions of rural kitchen stoves that can be replaced with modern low emission variants. The Swiss initiative does hence not necessarily compete with the country’s own projects as there is room to build millions of such stoves elsewhere in Peru.

Informants tell that Klik’s application for certification of ITMOs on this project is today being evaluated by the relevant ministries according to what the two parties decided on process in their agreement. They are especially waiting for the decision of the Peruvian Ministry of Energy and Mining, who has the power to classify all clean burning kitchen stoves to be the unique right and responsibility of the Peruvian government in the fulfilling of their NDC. If so, the Swiss’ right to ITMOs evaporates and the initiative is reduced to a privately financed development cooperation project.

In hindsight it seems reasonable to ask why the Swiss government accepted such elevated risk and how come the Peruvian government has not been able to finalize all details of the agreement in five years? The Swiss government perceives their innovative efforts to develop a worldwide system of carbon emission trading under §6.2 to be classified as development aid according to ODA criteria set by OECD. Their objective is seemingly self-interest in reducing the cost of their own NDC fulfillment through purchasing inexpensive ITMOs, but the development of a functioning §6.2 process that can be copied by other countries and sectors will benefit many more.

Once the setup works for their clean kitchen stoves projects and the ITMOs are successfully transferred to the Swiss NDC, other countries would seek similar agreements and be able to implement climate projects of all kinds with transfer of ITMOs in a much shorter time. Developing trade in carbon offsets in a new institutional setting can be considered an innovation from which both developing countries as potential sellers and developed countries as potential buyers could benefit.

4.3 Colombia - Skeptics evolving into market

4.3.1 The fuel emission tax

Colombia decided with the adoption of the Climate Change Law 1931 in 2018 to develop an Emission Trading System (ETS) by cap-and-trade (ICAP, 2024). The government's intention was to auction 169 MtCO_{2e} to achieve the Colombian NDC of 51% emission reduction. However, the government has not been able to develop this ETS further and has so far only been able to implement a tax on transport fuels. The fuel distributors are however allowed to substitute the tax with certified GHG reductions from many types of climate projects. The producers and buyers of such GHG emission reductions meet in a free market to negotiate contracts. The prices tend to be just below the 5 USD/tCO_{2e} tax. This indicates a well-functioning and transparent market where the buyer most of all values the tax reduction effect rather than public image effect.

The incumbent leftist government of Gustavo Petro has not developed the formulation and implementation of an ETS in Colombia further due to ideological and practical reasons. The former Minister of the Environment and Sustainable Development, Susana Muhamad, was known as a fierce opponent of carbon markets like many others in the government. The incoming minister, Lena Estrada Añokazi, is an academic of indigenous origin and is expected by informants to be more positive. The discussion on the development of a framework and prepare the institutions for trade in carbon offsets in host countries is assisted by the international organization Global Green Growth Institute (GGGI) often financed by one of several of a potential purchasing country.³²

The main reason for resistance towards carbon markets and a preference for direct interventions to stop deforestation and other climate challenges is the perceived failure of internal carbon credit market in Colombia, which was introduced by the former right leaning and market friendly government of Ivan Duque in 2018. The possibility to substitute with carbon offsets led to many afforestation and REDD+ plus projects with private landowners

³² GGGI has a standing as an organization that is willing and able to act independently for the benefit of all parties, e.g. Norway finances GGGI activity in the country's main \$6.2 partner Senegal.

as well as indigenous and afro-Colombian communities that possess joint landownership in the Amazon and the rainforest on the Pacific Coast.

The outcomes remain contested both in terms of deforestation impacts and effects on local communities. Some communities signed agreements with project developers which later turned out to be disadvantageous for them, leading to claims of corrupt leadership and internal conflicts. Furthermore, the project developers reported too pessimistic baselines with high deforestation rates that were accepted by the certification bodies. The resulting more realistic business-as-usual deforestation rate would then appear as successful climate interventions and rewarded by millions of dollars. The national certification body Acercarbono was notoriously known to have a blind eye to the practice and even recognized certification bodies like Verra to admit having wrongly certified too high GHG emission reduction claims. The buyers did not oppose the practice as long as the certificates were accepted by the tax authorities of this compliance market. The government and tax authorities had too little resources and insight to actually control the GHG emission reduction claims and oversee certification bodies (control the controllers). Markets based on difficult-to-verify emission claims are vulnerable to manipulation in the absence of credible oversight mechanisms.³³

4.3.2 Expected internationalization with change in government

Colombian politics are volatile and antagonistic, which implies that regulations and most importantly the enforcement of the regulations differ between governments. The far-right president Uribe that fought the FARC guerrilla fiercely was then replaced by central-right president Santos who immediately started to negotiate a peace agreement that was signed in 2016 in spite of a negative referendum, leading the far-right president Duque to power in 2018. With a strong belief in private markets, he introduced the carbon emission tax

³³ The Colombian idiom «regalar papaya» translates to «gifting papaya (fruit)» and reflects the ethical perspective that if someone trust other and then get cheated, the truster is to be blamed as it made it too tempting for the entrusted to cheat.

exemption through carbon credits, later refuted by the current ex-guerrilla and ideological left president Petro who came to power in 2022.

Several informants described the Petro administration as institutionally fragmented and politically unstable. More importantly, current and previous government insiders indicate that president Petro has only a limited interest in climate policies. However, part of the explanation is a lack of support in the congress which stops most of his initiatives.

Most informants expect a radical change when the new government is elected in June 2026 either through the election of left candidate Cepeda who appears to be more structured or through the a right wing candidate. The latter will most certainly imply more market-based climate solutions and business friendly policies. The vital element will be whether they will understand that GHG emission reduction production will require investments that will only be profitable if the production units are well paid for their climate effect, either through (i) the introduction of a national restrictive ETS market bringing up prices or (ii) through the acceptance of corresponding adjustment required for GHG emission reduction exports under PA §6.2, ICAO-CORSIA and probably ITMO.

4.4 Institutional failure and small state apparatus

Both countries suffer from too weak institutions to really benefit from §6.2 trade. The Colombian resistance against accepting offers from other countries to finance climate projects might seem irrational. Host countries are free to choose which projects to accept. They can choose cheap measures for their own NDC (low-hanging fruits) and leave the more expensive ones for international investors, which may still find the price attractive as the cost is considerably lower than in their own country. Host countries are free to negotiate the retainment of parts of the resulting CO2 emissions and the very first project implementation should be considered an innovative process that will probably lower the cost of similar projects conducted by the host country themselves.

The building of clean burning kitchen stoves in rural homes financed by Swiss Klik in Peru is one example. Such stoves also constitute one³⁴ of the government's 66 measures for their own NDC fulfillment (Minam, 2024). In theory, the other countries rather finance projects not on the list in order to secure "additionality" as defined in the PA6.2 regulations.³⁵ Otherwise, there is a risk that the early projects conduct the cheapest solutions and leave the more expensive for the host country. The export of cheap emission reductions to other countries will weaken the host country's ability to fulfill their own NDC as only high-cost projects remain.

There is a need for millions of such clean kitchen stoves in rural Peru. Klik therefore concentrated on their activity to only three administrative regions in the North. The Peruvian government will hence have access to valuable experience when they start to build similar projects in the remaining 22 regions of the country. There is hence no crowding out and Peru is in principle open also for foreign financing and transfer of ITMOs from any of the listed 66 climate measures to be implemented by the country itself.

PA6.2 sales should similarly just represent possibilities rather than restrictions for the Colombian government. However, considerable bureaucratic resources are necessary to manage such certification and transfer system in a credible and transparent manner. The Colombian ministries lack professional staff and capabilities to effectively manage the 6.2 system on one side and they furthermore lack territorial control over the countryside. Both issues increase the risk for mismanagement, falsified emission reductions, and potential exploitation of indigenous communities, hence causing more harm than good to Colombia.

The government has instead decided to use limited funds and bureaucratic resources to finance and implement concrete climate projects, especially in the Amazon rainforest. This approach gives them control over both the implementation and the outcome. In addition, the government also believes it is of vital importance to increase the presence of the state in the countryside which today is dominated by criminal groups. Climate projects with benefits

³⁴ The clean energy measure "ECE9 Cocci3n limpia (Clean combustion)"

³⁵ «Additionality» means that the emission reduction from the project will come in addition to the host country NDC and is not linked to profitability in any sense.

to the population without creating conflicts is a good opportunity to build citizenship. The by-product of state-building can hence be just as important as the emission reduction effect.

5 Conclusions

This article has examined how cooperative bilateral agreements under §6.2 of the Paris Agreement are implemented in practice through a comparative analysis of Peru and Colombia. The analysis shows that §6.2 does not constitute a unified global carbon market, but rather a decentralized system of nationally defined frameworks, where institutional design varies significantly across countries.

The current left-wing Colombian government has organized their development of processes to align to §6.2 on hold due to lack of administrative resources. Their fundamental skepticism towards market solutions to climate policies was furthermore aggravated by the historical experience of not being able to stop fraudulent overestimation of GHG emission reductions in a national carbon offset for carbon tax scheme for the transportation fuel sector.

Peru on the other hand early embraced the possibility of external financing of climate projects under §6.2 and started to formal negotiations of a bilateral agreement with Switzerland as early as 2018. The Peruvian Ministry of Environment had then already developed payment for climate results systems in collaboration with the World Bank for many years, and where as a result well prepared to formulate a process that would comply with both UNFCCC §6.2 regulations as well as Swiss requirements to the bilateral agreement. Unfortunately, the progress advances slowly and no actual transfers of ITMOs have taken place so far. The reason is a mix of bureaucratic weaknesses of the responsible Ministry of Environment to obtain the necessary input and acceptance from the stronger Ministry of Energy and Mines and no urgent need for funds as the country receives more mining tax income than the government is able to spend. The Peruvian government approved the Swiss financed clean kitchen stoves as the first project to be included in the National

Registry of Mitigation Activities (RENAMI) in February 2026. Once the actual transfer of ITMOS related to this project from Peru to Switzerland takes place it is expected that many more will take place.

The findings suggest that §6.2 remains institutionally immature at least on the supply side. Although institutional frameworks and bilateral agreements are increasingly in place, the number of completed ITMO transfers remains limited. This suggests that the effectiveness of Article 6.2 will depend not only on its theoretical efficiency gains, but also on the evolution of national regulatory systems and their ability to generate credible and scalable mitigation outcomes.

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