The Future of the Clean Development Mechanism under a New Regime of Higher Climate Ambition

Author: Kristin Qui, Environmental Defense Fund

Abstract:

This paper discusses the environmental implications of using carbon credits from the Kyoto Protocol's clean development mechanism (CDM) to meet requirements under the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) and nationally determined contributions (NDCs) under the Paris Agreement. First, the paper discusses the history of the CDM and its design and methodologies in relation to environmental integrity and ambition. Second, the paper considers the effects of various options, including vintage and geographic origin restrictions, which are under consideration in international fora, in light of three principal concerns about the potential CDM supply, i.e., (i) questions about the environmental integrity of some CERs, particularly those originating in large countries, (ii) uneven geographic distribution of projects and, (iii) implications for ambition if units are double counted. Third, it presents an analysis of the potential pre-2020 and post-2020 carbon credit supply from CDM projects and programmes of activities, taking into account the possible vintage restrictions and other options currently under consideration. Fourth, the paper explains that the purposes of the CDM specified in the Kyoto Protocol do not include CORSIA compliance; thus, an amendment of the Protocol is necessary in order for certified emission reductions from the CDM (CERs, or CDM credits) to be so used. If the Parties to the Kyoto Protocol were to amend the Protocol, this paper finds that the highest likelihood of delivering environmental benefits from CDM projects would arise from limiting use of CERs to those originating from projects and programmes of activities in small island developing states and least developed countries, provided that they satisfy quality and accounting standards, including the need to avoid double counting. The paper notes that using such credits from small island developing states and least developed countries could aid the transition from the Kyoto Protocol to the higher ambition of the Paris Agreement, under which Parties can use experience gained and lessons learned from the CDM. To the extent that limitations based on geographic origin prove infeasible, the paper further analyses limitations based on vintage, notes other proposals for restrictions based on project type, as well as provides EDF's analysis of the effect of vintage restrictions.

TABLE OF CONTENTS

LIST OF ACRONYMS

BAU	Business-as-Usual
CAEP	Committee on Aviation Environmental Protection (ICAO)
CDM	Clean Development Mechanism (established by the Kyoto Protocol)
CERs	Certified Emissions Reductions (from the CDM under the Kyoto Protocol)
CMP	Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol
COP	Conference of the Parties
CORSIA	Carbon Offsetting and Reduction Scheme for International Aviation
CPAs	Component Project Activities (under Clean Development Mechanism programmes of activities)
DG-Clima	European Commission Directorate-General for Climate Action
ICAO	International Civil Aviation Organisation
ITMOs	Internationally Transferred Mitigation Outcomes (under Article 6.2 of the Paris Agreement)
LDCs	Least Developed Countries
MBM	Market Based Measure
NDC	Nationally Determined Contribution (under the Paris Agreement)
PA	Paris Agreement
PoAs	Programmes of Activities (under the CDM)
QELRCs	Quantified Emissions Limitation and Reduction Commitments (under the Kyoto Protocol)
SARPs	Standards and Recommended Practices
SIDS	Small Island Developing States
TAB	Technical Advisory Body (under ICAO)
UN	United Nations
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change

1. Introduction: International MBMs

The International Civil Aviation Organisation (ICAO) adopted the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) in October 2016 as its global market-based measure (MBM) to limit net CO_2 emissions from international civil aviation to 2020 levels ("carbon neutral growth from 2020").[1,2] ICAO's Committee on Aviation Environmental Protection (CAEP) estimates that international aviation fossil fuel consumption will roughly treble or quadruple by 2040.[3,4] Leaving CO_2 emissions from aviation unchecked could undermine the world's ability to meet the climate safe-guarding goals of the 2015 Paris Agreement (PA) and the 1992 United Nations Framework Convention on Climate Change (UNFCCC).

CORSIA is not the first UN-established international MBM to address greenhouse gas emissions. Three market-based instruments were established by the 1997 Kyoto Protocol (KP). First, the Conference of the Parties (COP) established the clean development mechanism (CDM) to assist developing country Parties to the UNFCCC in achieving sustainable development while simultaneously helping industrialized country Parties[5] to meet their economy-wide quantified emissions limitation and reduction commitments (QELRCs) under Article 3 of the KP. Second, Article 6.1 of the KP established joint implementation, by which any Party included in Annex I may transfer to, or acquire from, any other such Party, emission reduction units resulting from projects aimed at reducing greenhouse gases (KP Article 6.1). Third, KP Article 17 states that Parties included in Annex B may participate in emissions trading for the purpose of fulfilling their commitments under KP Article 3 (KP Article 17).[6] Articles 3.10, 3.11, and 3.12 of the KP establish accounting rules for the operation of these instruments.

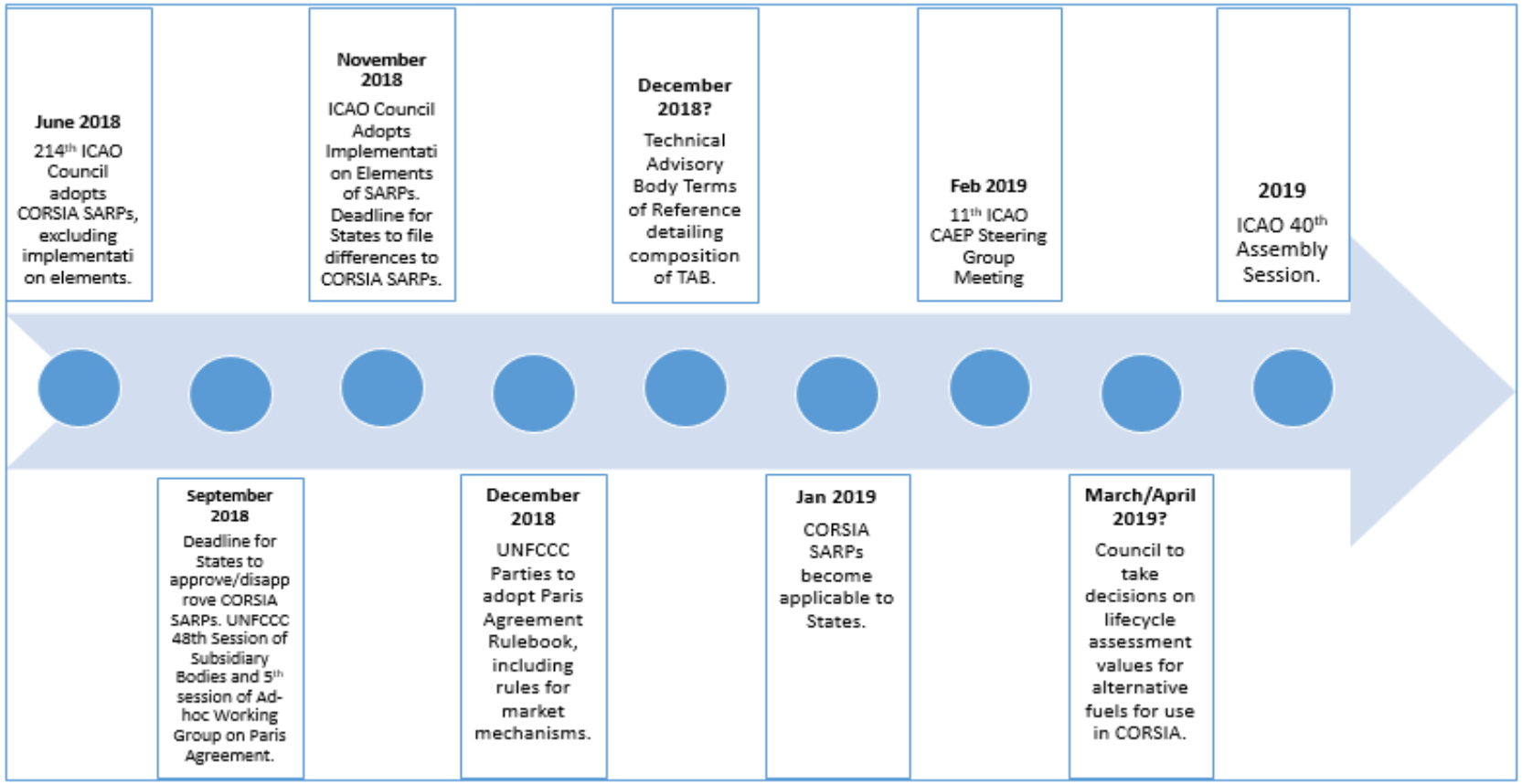
The PA is another important UN agreement that addresses MBMs for reducing emissions. Adopted by the COP in 2015, the PA aims to strengthen the global response to the threat of climate change by holding the increase in global average temperature to well below 2˚C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5˚C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change (PA Article 2.1(a)). To meet the goals of the PA, each Party shall prepare, communicate and maintain successive nationally determined contributions (NDCs) that it intends to achieve and shall pursue domestic mitigation measures, with the aim of achieving the objectives of such contributions (PA Article 4.2).[7]

PA Article 6 recognizes that some Parties choose to pursue voluntary cooperation in the implementation of their NDCs to allow for higher ambition and promote sustainable development and environmental integrity (PA Article 6.1). This voluntary cooperation includes the use of internationally transferred mitigation outcomes (ITMOs) towards NDCs (PA Article 6.2), and PA Article 6.4 establishes a mechanism, for use by Parties on a voluntary basis, to promote the mitigation of greenhouse gas emissions and foster sustainable development, to incentivize and facilitate participation in the mitigation of greenhouse gas emissions by public and private entities authorized by a Party, to contribute to the reductions of emissions levels in the host Party, and to deliver an overall mitigation in global emissions.[8]

This paper discusses the environmental implications of using certified emission reductions (CERs) from CDM project activities as explained under Article 12 of the KP, to meet CORSIA requirements and/or NDCs. It presents an analysis of the pre-2020 and post-2020 potential carbon credit supply from CDM projects and programmes of activities (PoAs) in several countries, with particular emphasis on those in small island developing states (SIDS), least developed countries (LDCs) and African countries.

Year-2018 is an important year for CORSIA and for the PA as Parties work to adopt all aspects of the standards and recommended practices (SARPs) for CORSIA, and develop the guidance for PA Article 6.2 implementation and the rules, modalities and procedures for PA Article 6.4. The COP is working to finalize the PA work programme (the "Paris rulebook") at the latest by the 24th COP in December 2018 (Decision 1/CMA.1).[9] On June 27, 2018, the 36-member ICAO Council adopted the CORSIA SARPs. [10] However, the Council has yet to adopt some parts of the important Implementation Elements, an attachment to the SARPs, which include details on CORSIA Eligible Emissions Units, Sustainable Aviation Fuels and criteria for both.[11] The Technical Advisory Body (TAB) that will make recommendations to the Council on the eligible emissions units for use by CORSIA, referenced in paragraph 20 (d) of the ICAO Resolution A39-3, has yet to be established by the Council.[12]

Figure 1. Timeline for finalizing the CORSIA SARPs.



2. Historical Background of the CDM and areas for improvement

2.1. Historical Background

In 1997, KP Article 12 established the purpose of the CDM: "The purpose of the clean development mechanism shall be to assist non-Annex I Parties with their sustainable development, and to assist Parties included in Annex I in meeting their KP Article 3 quantified emission limitation and reduction commitments" (KP Article 12.1). The CDM was not designed to achieve global mitigation. Instead, by its terms, it provides Annex I Parties with access to cheaper options for reducing emissions and flexibility in the location of reductions.[13] In 2001, the COP decided to facilitate a prompt start for the CDM (before entry into force of the KP in 2005) by adopting the modalities and procedures contained in the annex to Decision 17/CP.7.[14]

An executive board, comprised of elected members, supervises the CDM as stated under KP Article 12.4. Members of the executive board shall have no pecuniary or financial interest in any aspect of a CDM project activity or any designated operational entity.[15] The executive board is responsible for managing the work of the CDM and defines the services and administrative support functions required by the Executive Board and its panels, committees and working groups, and the financial resources to support this work.[16] Once CERs have been approved under CDM processes, the executive board has no power to remove emissions reductions certifications retroactively, even if the units have been found to be fraudulent; however, governments have on occasion withdrawn registration of problematic CDM projects, e.g. the Barro Blanco Dam project in Panama.[17]

Some experts recognize the CDM for incentivizing numerous mitigation projects in developing countries and for its continuous reforms.[18] Government representatives involved in climate negotiations often welcome some of the CDM's methodologies, including methodologies for projects that, without investment from the CDM, are particularly vulnerable to discontinuation, such as methodologies for projects like methane avoidance, biomass energy and landfill gas removal. Representatives from SIDS and LDCs further appreciate the CDM programmatic approach, under which it is possible to register a coordinated implementation of a policy, measure, or goal that leads to emission reductions. Once a PoA is registered, an unlimited number of component project activities (CPAs) can be added without undergoing the complete project cycle.[19] This has several benefits for small developing countries including minimization of cost, faster processing times, access for small-scale projects and ability to scale-up.[20]

Another lauded aspect of the CDM is the adaptation fund, established by Decision 10/CP.7 and financed from a two per cent share of proceeds on CDM project activities and other sources of funding. The fund supports concrete adaptation projects and programmes in developing country Parties to the Protocol.[21] Since 2012, and with the Doha Amendment not yet entered into force, the CDM has been characterized by high supply and low demand, resulting in low CER prices and sales.[22] This has undoubtedly affected the share of proceeds flowing to the adaptation fund, creating a significant challenge for SIDS and LDCs who are still in need of direct access funding for adaptation.

2.2. Why the CDM's design is insufficient under a more ambitious climate regime

2.2.1. CDM is not designed to deliver an overall mitigation in global emissions.

While the CDM provides helpful experience to inform the design of cooperative approaches under the PA, there is significant room for improvement. The offsetting design of the CDM means that emissions from Annex I Parties exceed their KP assigned amounts after purchasing and using CERs. The result is that global emissions continue to increase along the sum of the Annex I Parties' emissions caps plus the non-Annex I Parties' business-as-usual (BAU) trajectory – with the amount of reductions achieved in non-Annex I Parties simply shifted over to emissions increases above the caps of Annex I Parties. However, global emissions need to go down to achieve the PA temperature goals and PA Article 6.4(d) specifically states that the PA Article 6.4 mechanism shall aim to deliver an overall mitigation in global emissions. Under the current CDM design, BAU in non-Annex I Parties is increasing, and a mechanism that simply shifts such BAU increases from non-Annex I to Annex I Parties does not reduce global emissions.

2.2.2. Additionality and inflated baselines.

Empirical evidence indicates that the two main characteristics related to CDM project eligibility and crediting – additionality and baselines – are difficult to define with certainty. Many project activities approved by the CDM as "additional" have in fact been found to be non-additional, and a significant number of CDM-approved baselines have been found, upon review, to result in over-crediting.[23]

Text Box. 1.

Example 1. Hydroelectric Dams in Brazil.[25] The proponents of three large dam projects, the Santo Antônio, Jirau and Teles Pires hydroelectric power plants, claimed that these projects required revenue from CDM credits to attract investment. At the same time, the proponents told potential investors that they would earn a profit if they invested in the dams, thus raising the likelihood that the dams did not require carbon revenue and were therefore not "additional." The dams are now operating, even though the current value of the carbon credits is zero. Since the CDM projects are generating no revenue, any emissions reductions attributable to the dams would have happened without the projects. The credits represent "hot air", or fictitious emissions reductions.

Example 2. HFC-23 baseline inflation.[26] HFC-23 is an unwanted waste gas from the production of hydrochlorofluorocarbon-22 (HCFC-22); a GHG and an ozone-depleting substance with a global warming potential of 11,700. HCFC-22 plants produced significantly less HFC-23 during periods when no emission credits could be claimed compared with periods when HFC-23 destruction could be credited under the CDM. Moreover, the total amount of HCFC-22 produced appears to be determined mainly by CDM rules. This suggests that the claimed emission reductions may partly not be real and that the CDM provides perverse incentives to generate more HFC-23, illustrating the incentive to increase projected baseline emissions to earn more revenues.

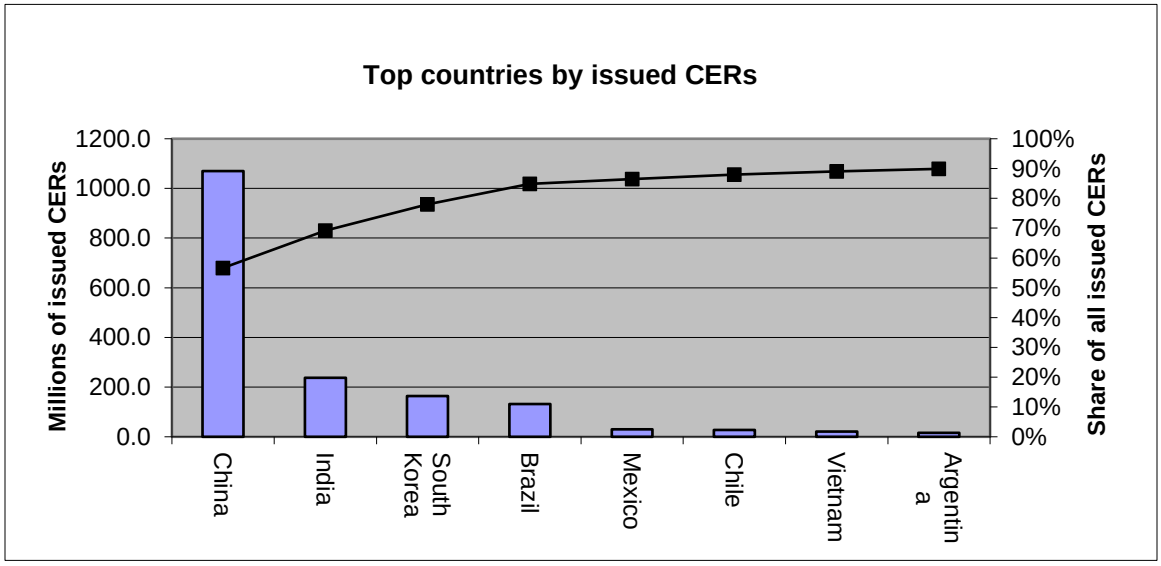
Example 3. CDM Methodologies.[27] Methodology AM0019, "Renewable energy projects replacing part of the electricity production of one single fossil fuel fired power plant that stands alone or supplies to a grid, excluding biomass projects," provides a procedure for earning credits for emissions reductions associated with displacing electricity from a fossil power plant by a renewable energy power plant. This means that an entity can earn a large amount of credits for one renewable energy project (including hydro-projects) that replaces the electricity from a fossil-fired power plant. This creates an incentive to inflate the baselines of the fossil-fired power plant to earn even more credits.

The first characteristic, additionality, is counterfactual, which makes it very difficult to determine whether a CDM project activity would have occurred in the absence of the CDM.[24] For some existing CDM project activities, emission reductions would have been achieved even in the absence of the CDM, which demonstrates the perverse incentive to defer abatement in order to maximize profit from the sale of CERs (see Text Box 1 for examples).[25,26,27] The CDM also creates an incentive to increase actual baseline emissions to earn higher revenues from CERs sales (leading to over-crediting and increasing rather than decreasing global emissions). Increasing projected BAU emissions is another related perverse incentive under the CDM rules, as project proponents have an incentive to overstate emissions reductions generated by any given project,[28] and as firms and industries have an incentive to inflate their crediting baselines to reflect larger emission reductions and maximize CER revenues.[29] If this in fact does occur (e.g. with HFC-23 destruction projects and dam projects in Brazil) reductions are not real. In fact, the CDM methodologies encourage baseline inflation (see Text Box 1.).[30,31]

2.2.3. Uneven geographic distribution of CDM projects.

Geographic distribution of CDM project activities has been uneven, with a large volume of CERs originating only in two regions.[32] This means that many other developing countries, those particularly in need, have been crowded out by a few host countries. Thus, to the extent that the CDM actually is working to reduce emissions, only a few host countries reap its benefits, thereby hindering the purpose of the CDM under the KP, i.e. "to assist non-Annex I Parties with their sustainable development," (KP Article 3.1). As Figure.2 illustrates, most issued CERs originate in China, India and Brazil, effectively crowding out the most vulnerable countries to climate change, like SIDS and LDCs. In fact, China, India and Brazil have about 85% of the total CER issuance.[33]

Figure 2. Top Countries by issued CERs. Source: UNEP DTU Partnership[34].



2.2.4. Lack of Transparency

A study on the integrity of the CDM, commissioned by the European Commission Directorate – General for Climate Action (DG Clima), finds that key limitations of the CDM include perceptions regarding the lack of transparency and inconsistency of Executive Board decisions. The authors state, "Stakeholders are concerned about a perceived lack of transparent and consistent decisions, ineffective communications, Executive Board conflicts of interest and other issues."[35] The Annex to Decision 3/CMP.1 states that the CDM Executive Board shall develop and maintain the CDM registry.[36] The Executive Board shall establish and maintain a CDM registry to ensure the accurate accounting of the issuance, holding, transfer and acquisition of CERs by Parties not included in Annex I and shall make non-confidential information publicly available and provide a publicly accessible user interface through the Internet that allows interested persons to query and view it (Decision 3/CMP.1, Appendix D).[37] However, there is no publicly available database showing cancellation or retirement of CERs for purposes of meeting Kyoto Protocol emissions limitation and reduction commitments – so assessing the effectiveness of the CDM by analyzing the issuance and actual use of CERs for compliance with KP mitigation requirements is challenging at best.

2.2.5. Legal Uncertainty of using CERs from the CDM for mitigation purposes not under the Kyoto Protocol, including use of CERs post-2020

The future of the CDM is legally uncertain. The CDM Executive Board arguably has no legal authority to issue CERs after 2020, and may not have authority to issue CERs now. The KP, as stated above, establishes the CDM only for the twin purposes of helping non-Annex I Parties with sustainable development and Annex I parties to meet their QELRCs. The KP and its Doha Amendment specify two commitment periods during which Annex I countries must meet their QELRCs. The first period was from 2008-2012 (KP Article 3.7). In 2012, The Doha Amendment established the second commitment period as 2013-2020, but it has not yet entered into force (KP Doha Amendment Article 3, paragraph 1 bis).[38] The Conference of the Parties serving as the Meeting of the Parties to the Kyoto Protocol (KP CMP) decided that only Parties with binding limits under the Kyoto Protocol, i.e. QELRCs, can transfer and acquire CERs, but an Annex I Party can continue to participate in ongoing CDM project activities, including those registered after 31 December 2012.[39] No decision has been made by the CMP or the COP authorizing the use of CDM CERs for anything other than to meet an Annex I Party's QELRC. As the only entities with legal competence to decide the uses of CERs, the COP and the CMP must address – by means of an amendment to the KP or by duly taken decisions - the future of the CDM if members of other instruments (ICAO, the PA) wish to use CERs to meet obligations under those instruments. In addition, the other instruments would need to take decisions confirming that the CERs meet the criteria and rules they have established for use of emissions units under their respective instruments.

3. Future use of CERs

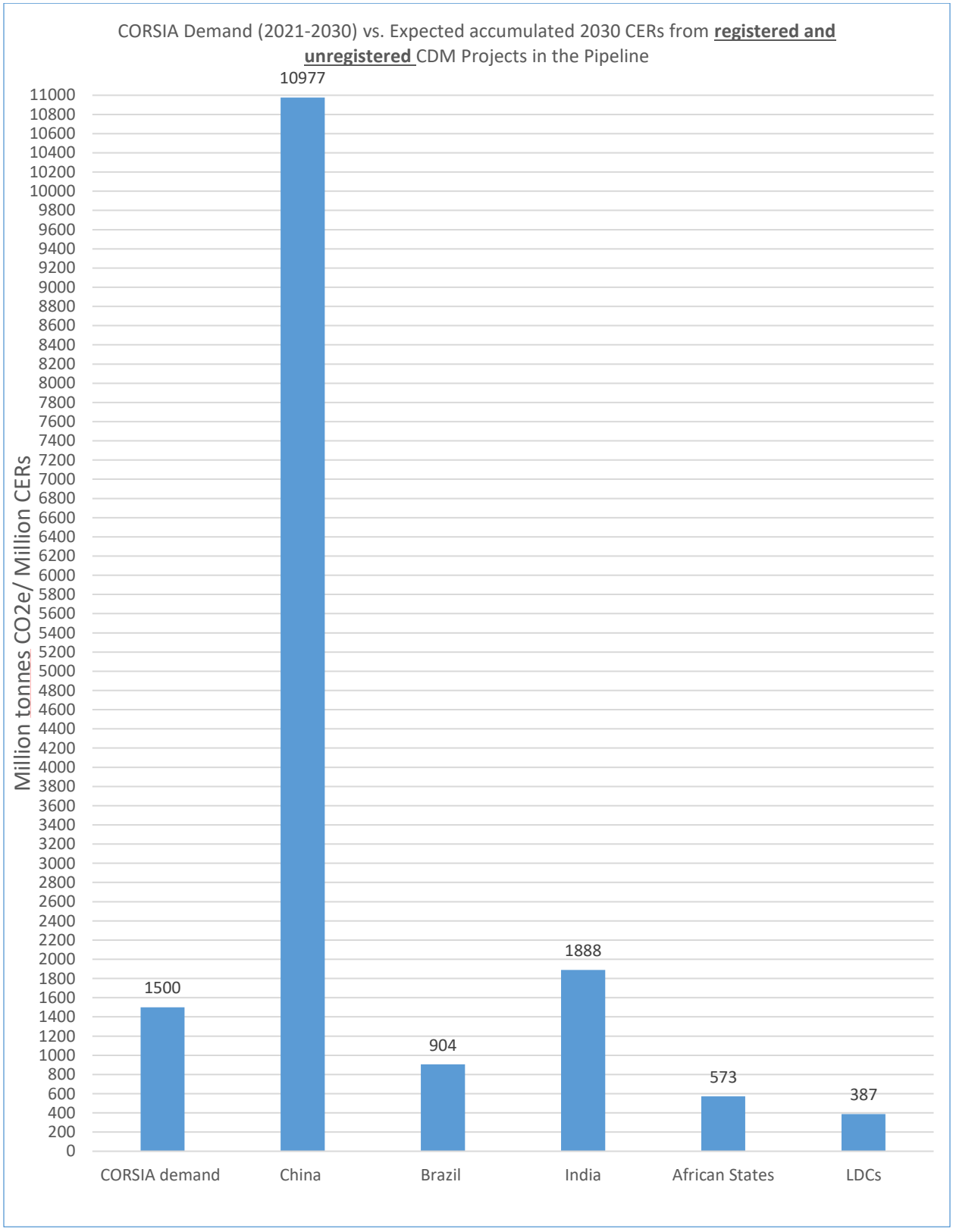
International discussions and negotiations are considering future use of CDM CERs in other instruments, such as to meet CORSIA requirements and towards meeting NDCs under the Paris Agreement. (If the Kyoto Protocol Parties decide to allow such uses, one potential avenue for such CERs to formally be recognized in the context of the Paris Agreement might be via the mechanism established under PA Article 6.4.) This paper contributes to existing analyses of supply of CERs, recognizing that the potential use of all CERs will not promote environmental integrity or trigger the reductions necessary to achieve the goals of the PA and will not address the fundamental flaws of the CDM described in the previous section. As noted above in section 2.2.5, the legal use of CERs is uncertain and use of CERs for any mitigation commitment other than QELRCs will require a decision by the COP and the CMP authorizing such. The other instruments, such as ICAO and the Paris Agreement, would need to take decisions confirming that the CERs meet the criteria and rules they have established for use of emissions units.

Despite the challenges described in Section 2 above, the CDM's standards, procedures and institutional arrangements provide important lessons for improving the design of future international crediting mechanisms.[40] Studies suggest that the KP second commitment period has a potential supply of 4.3 – 5.7 billion CERs from registered and unregistered projects.[41,42] Several factors may significantly reduce this large potential. The latest study on the implications of current CER supply states that a 2016 vintage restriction applied to the date of emission reductions reduces the available supply to approximately 2.9 billion CERs.[43] Based on previous CDM projects CER issuance is often less than expected. For this reason, several studies apply a CER issuance rate, which is the ratio between actual CERs issued and the estimated number in request for registration, to determine future CER supply.[44] Actual issuance rates have varied over the years of the CDM's existence for a number of reasons, including because of action taken by the EU, in response to lack of additionality concerns, to narrow its scope of CERs acceptable in the EU-ETS, which caused a sharp reduction in demand for CERs. The decline in CER prices further depressed issuance rates as project proponents stopped requesting issuance as a result of the decline in demand. A report completed by the New Climate Institute for the German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB) finds that on

average, the projected credit supply from 2015-2020 will be around 26.4% of the theoretical maximum credit supply.[45] The World Bank's State and Trends of Carbon Pricing 2016 Report predicts about 15% of the total potential supply of CERs to be actually available in the future[46]. Applying the rate of issuance adjustment would significantly reduce the potential 4.3 -5.7 billion CERs supply to somewhere between 705 million – 1.24 billion CERs.

To emphasize the necessity of taking vintage and/or geographic restriction decisions regarding future use of CERs, the following graph (Figure 3) illustrates that if CDM projects are extended out to 2030, the expected accumulated 2030 CERs from CDM projects in the pipeline from large countries like China could potentially be up to 10 times greater than CORSIA demand through 2030. These numbers include all the CDM projects in the pipeline from both commitment periods from the respective countries, including unregistered projects. Issuance rates would decrease the numbers, but it is important to recognize what could occur if all CERs were issued. This would crowd out any other countries that are in need of climate finance, perpetuating the uneven distribution of CDM projects. There is also a risk that if these credits are CORSIA-eligible, they may consist of low-quality credits from projects that are non-additional or over-estimated, as explained in Section 2. The demand for emissions units to meet CORSIA requirements from 2021-2035 is estimated at approximately 2.5 billion tonnes.[47] PA Article 6.2 and the PA Article 6.4 mechanism may provide additional supply after implementation. Demand for emissions units may increase as countries work toward their increasingly ambitious mitigation targets to meet the 1.5˚C to 2˚C goal of the PA.

Figure 3. CORSIA demand (2021-2030) compared to maximum potential supply up to 2030 from CDM projects in the pipeline.



3.1. Reasons to limit future use of CERs to those from SIDS and LDCs

An option for using CERs to meet mitigation commitments other than those under the Kyoto Protocol is to limit use of CERs to only those that originate from CDM Projects and PoAs in SIDS and LDCS, which the following reasons justify.

3.1.1. SIDS and LDCs have been crowded out of the CDM

The number of CDM projects in SIDS and LDCs is disproportionately low despite the fact that these countries require climate finance in excess of what is currently available. As mentioned in Section 2.2.3, only a few host countries have accessed the sustainable development benefits promised by the CDM. SIDS and LDCs are the most vulnerable to the impacts of climate change despite their negligible contribution of greenhouse gas emissions.[48] The cost of adaptation is estimated to be billions of dollars annually in Africa alone, where 34 countries are LDCs; and SIDS have experienced climate-related disasters that can erase decades of development in a single event.[49] The sale of CERs from CDM project activities (and PoAs) in a market with balanced supply and demand can contribute to the adaptation finance needed by SIDS and LDCs, while simultaneously helping to meet mitigation commitments under the PA. Using a credible subset of CERs will also smooth the transition from the CDM (and its adaptation fund) to the Article 6.4 mechanism post-2020.

3.1.2. Projects in SIDS and LDCs may have high vulnerability to discontinuation

Many CDM projects raise environmental integrity concerns, as explained in Section 2.2.2. However, several types of projects in SIDS and LDCs are considered to have a greater likelihood of being additional when measured based on the important concept of *vulnerability to discontinuation without continued support from carbon finance.*[50] One study which classifies specific types of CDM projects according to their vulnerability of discontinuation finds that highly vulnerable projects include biomass energy, landfill gas, methane avoidance and household energy efficiency. The risk of discontinuation varies depending on the location and local context, but evidence shows that factors such as uncertain supply chains, lack of regulation and overall lack of financial incentive increase the vulnerability of these types of projects.[51] Among SIDS and LDCs, there are 24 methane avoidance projects, 22 landfill gas projects, 19 biomass energy projects and 15 energy efficient household projects in those countries (see Table 1). Therefore, a large number of projects in SIDS and LDCs have a high risk of discontinuation without support from the CDM.

3.1.3. Avoidance of Double-counting

Avoiding double counting is essential to preserving the environmental integrity of market mechanisms as it ensures real emissions reductions and contributes to the achievement of overall mitigation.[52] CORSIA and the PA include provisions to avoid double counting.[53] PA Article 4.13 states, "In accounting for anthropogenic emissions and removals corresponding to their nationally determined contributions, Parties shall promote environmental integrity, transparency, accuracy, completeness, comparability and consistency, and ensure the avoidance of double counting, in accordance with guidance adopted by the Conference of the Parties serving as the meeting of the Parties to this Agreement."[54] The CORSIA Emissions Units Criteria (EUC) also include the avoidance of double counting.[55] One form of double counting occurs where two or more Parties claim the same emission reduction to comply with their mitigation targets, e.g. a Party claims an emissions reduction to meet its NDC and sells that unit to an airline who claims the same unit to meet its CORSIA requirement (double claiming). The occurrence of double

claiming is less likely with CERs from SIDS and LDCs as they contribute less than 1 per cent of total greenhouse gas emissions and because they are strong advocates for environmental integrity, delivering overall mitigation in global emissions, and robust accounting through corresponding adjustments.[56,57] Double counting of emissions reductions occurring outside the NDC sector is also of significant concern, as studies indicate that double counting of units originating from mitigation activities outside the NDC sector could possibly undo all reductions achieved under current NDC scenarios.[58]

4. Potential Supply of CERs

The figures in this section show the maximum potential supply of CDM CERs from SIDS and LDCs, i.e. the number of CERs that could be available if all of the projects and PoAs (from SIDS and LDCs) in the CDM pipeline were fully issued, and if there was an incentive to register all currently unregistered projects and PoAs. However, as explained in the previous section, it is unlikely that full issuance will occur, thus the actual supply of these credits will be less than presented here. The figures also include the maximum potential supply that might be available with the inclusion of other African countries that are not considered by the United Nations to be LDCs.

The figures compare the impact of different vintage restrictions on the potential supply of CERs from projects and PoAs in SIDS, LDCs and other African countries. Vintage refers to a particular year that is associated with the carbon credit.[59] The first type of vintage restriction used in this paper is the "start date of the CDM project (or PoA)"; we consider such a restriction on projects that were implemented either before December 31 2013 or before December 31 2016. The start date of the project is the date on which project participants commit to making expenditures for the construction or modification of the main equipment facility or for the provision or modification of a service. The PoA start date is the date when the entity managing the programme officially notifies the UNFCCC of its intention to seek CDM status.[60] The second type of vintage restriction relates to the timing of issuance of emissions reductions and pertains to the administrative processes required under the CDM rules. It is crucial to note that the date of issuance can take place any time after the emission reduction took place, which means that these dates might reflect an emission reduction that took place earlier than recorded. Project participants/developers can therefore adjust the timing of an emission reduction for a CER that has not yet been issued but already occurred in response to enforcement of a vintage restriction on the date of issuance, which might reduce the environmental integrity of CERs.[61] However, using these two vintages allows for comparison between using a restriction related to project implementation and one related to the administrative processes of the CDM.

The CDM pipeline, created by the United Nations Environment Programme (UNEP) in partnership with the Technical University of Denmark (DTU), is the main resource for the figures presented in this section. The UNEP DTU Partnership created two comprehensive databases, one for CDM projects and another for CDM PoAs. The numbers shown in the following figures were obtained by extracting from the CDM pipeline databases, the relevant information for projects and PoAs in SIDS and LDCs.

The KP CMP established a platform for voluntary cancellation of CERs, and encouraged the CDM Executive Board to explore options for other uses,[62] but as noted above, to date it has not approved any other such uses. The calculations in this paper take into consideration the voluntary cancellations which have been recorded to date in the CDM pipeline. However, ***there is no publicly available domain showing cancellation or retirement of CERs for other***

purposes. For this reason, these figures depict maximum potential supply of CERs from SIDS and LDCs and not actual supply as some issued CERs have already been retired or cancelled for the purpose of meeting Kyoto Protocol QELRCs. Two members of the LDCs/SIDS groups, Burkina Faso and Singapore, have made pre-2020 pledges, but the status of these pledges is unclear. Hence, the numbers for the pre-2020 pledges are not included in this analysis.

Figure 4. Potential demand from CORSIA.

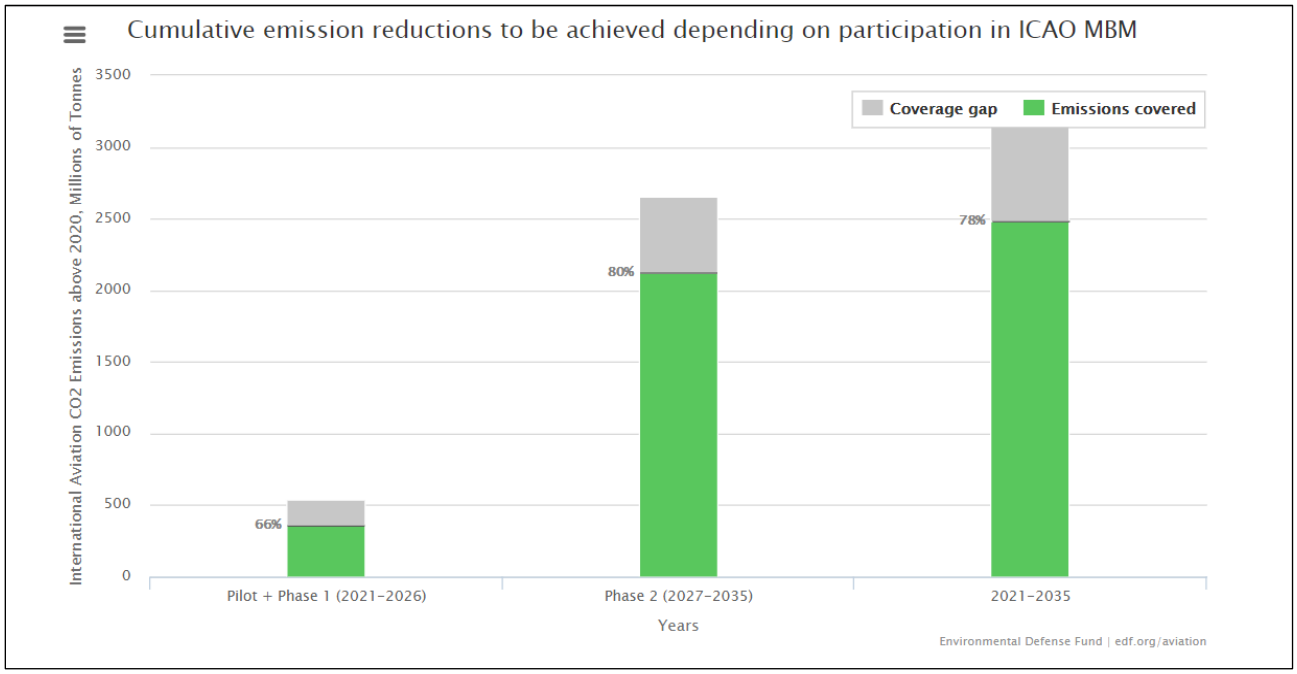


Figure 4 illustrates anticipated demand for emissions units from CORSIA at current participation levels (as of March 23, 2018).[63] It illustrates, for example, that during the years 2021-2026, CORSIA demand is anticipated to be a little less than 400 million tonnes cumulatively, over the 6-year period. That equates to, on average, between 60 and 70 million tonnes per year. These numbers will increase as more countries join CORSIA.

Figure 5. Total potential supply of pre-2020 and pre-2023 tonnes of CO_2e from CDM projects only in SIDS & LDCs

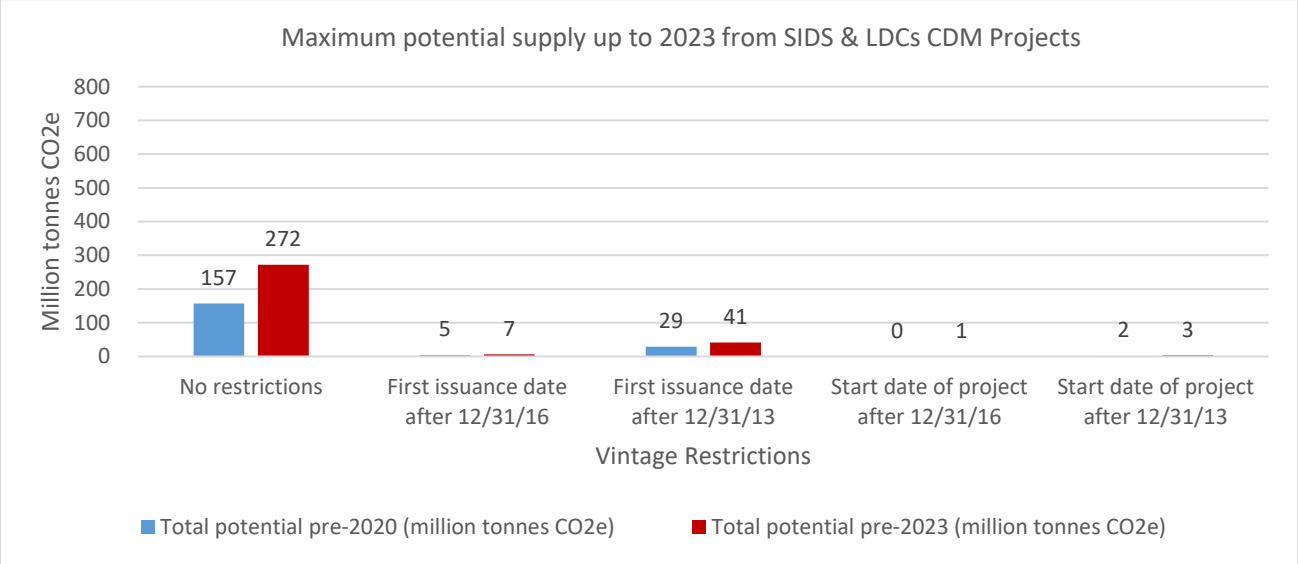


Figure 5 shows that in the absence of any vintage restriction, CDM projects in SIDS and LDCs have the potential to generate a maximum potential supply that is almost equal to the demand of the first three years of CORSIA. Up to 2020, CDM projects in SIDS and LDCs could potentially provide a maximum of approximately 157 million tonnes of CO_2e in emissions reductions. Applying vintage restrictions to this subset of CDM projects reduces maximum potential supply - with 5 million tonnes of CO_2e in pre-2020 emissions reductions available from projects with a first issuance date after December 31 2016. Extending the use of CERs out to 2023 will increase that supply slightly. Using a vintage of December 31 2016 for the start date of project gives just less than 1 million pre-2023 tonnes of CO_2e. These numbers are important for consideration by PA Parties currently negotiating the PA Article 6.4 mechanism rules, modalities and procedures, as these numbers can help to inform the transition to a higher ambition mechanism that delivers an overall mitigation in global emissions.

Figure 6. Comparison of start date vintage restriction on all CERs to CER supply from SIDS and LDCs, with and without the start date vintage.

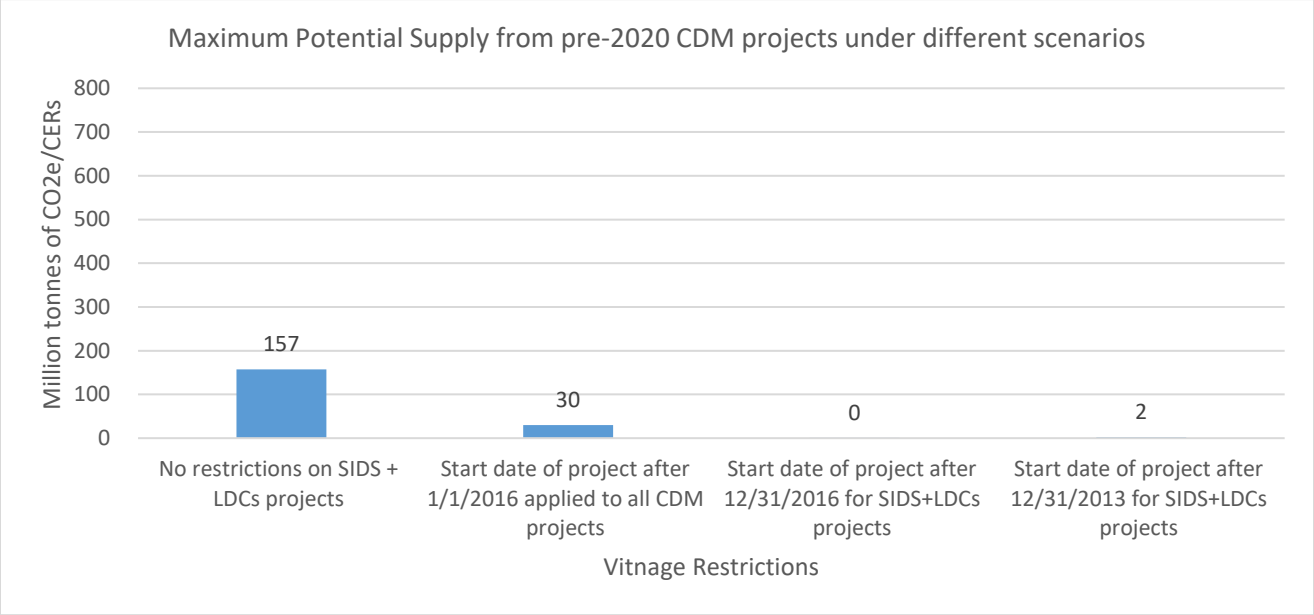
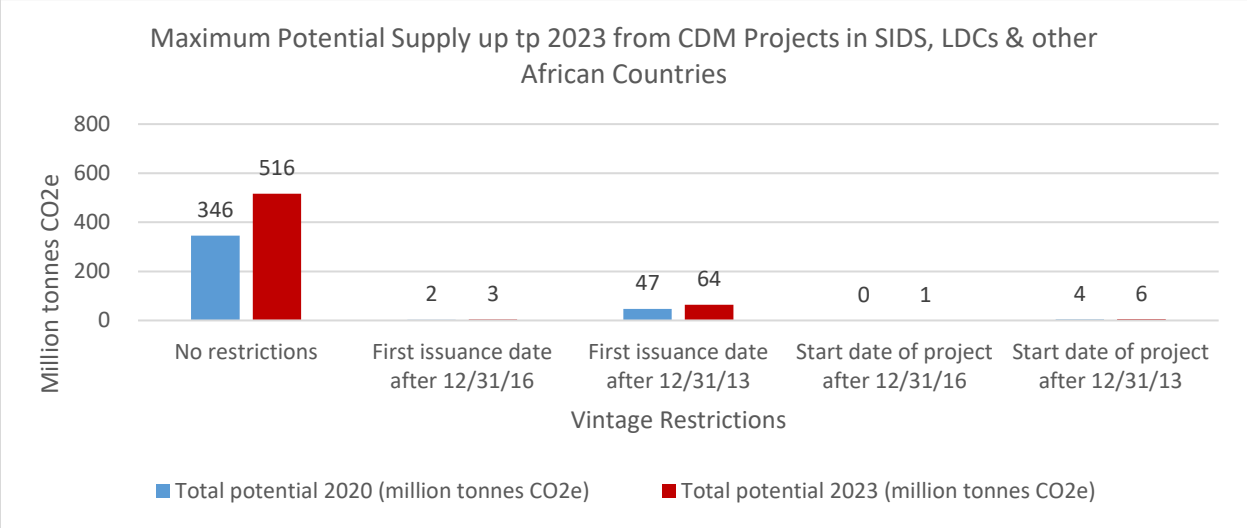


Figure 6 extends the analysis further to compare maximum potential supply after applying a vintage restriction of Jan 1 2016[1] to the start date of the project for all registered and unregistered CDM projects, regardless of country of origin. The figure shows that a maximum of 30 million CERs would be potentially available from unregistered and registered CDM projects if use of CERs were limited to only those from projects with a start date after December 31 2016.[64] The other values indicate the number of tonnes of CO_2e available from CDM projects in SIDS and LDCs, with: 1) no vintage restrictions applied, 2) a vintage restriction of December 31 2016 on the start date of projects from SIDS and LDCs and 3) a vintage restriction of December 31 2013 on the start date of projects from SIDS and LDCs. An important note is that while limiting all CERs to those with a project start date post-2016 addresses the particular challenge of over-supply of CDM CERs, this does not take into consideration the environmental integrity of the emissions reductions as projects with inflated baselines or questionable additionality may be included. Furthermore, restricting solely based on start date does not address the CDM challenge of uneven geographic distribution of activities.

[1] Data for start date of project after Jan 1 2016 obtained from Schneider, Lambert and La Hoz Theuer, Stephanie. "Using the Clean Development Mechanism for nationally determined contributions and international aviation – Assessment of impacts on global GHG emissions." *Stockholm Environment Institute* (2017), available at: https://www.sei-international.org/mediamanager/documents/SEI-PR-2017-Using-the-Clean-Development-Mechanism.pdf (accessed January 28 2018).

Figure 7. Total potential pre-2020 and pre-2023 supply of tonnes CO2e from CDM projects in SIDS, LDCs and the African Countries not categorized as LDCs.



Adding another scenario, the above figure depicts maximum potential supply from CDM projects in SIDS, LDCs and African countries that are not considered as LDCs, e.g. South Africa, Kenya, Ghana. Their inclusion increases the maximum potential supply in all scenarios while still addressing some environmental integrity concerns, as projects that are highly vulnerable to discontinuation, e.g. cook stove projects, can continue to provide real emissions reductions that would not have otherwise occurred with the CDM investments.

Figure 8. Total Potential pre-2020 and pre-2023 tonnes of CO_2e supply from CDM PoAs in SIDS&LDCs only

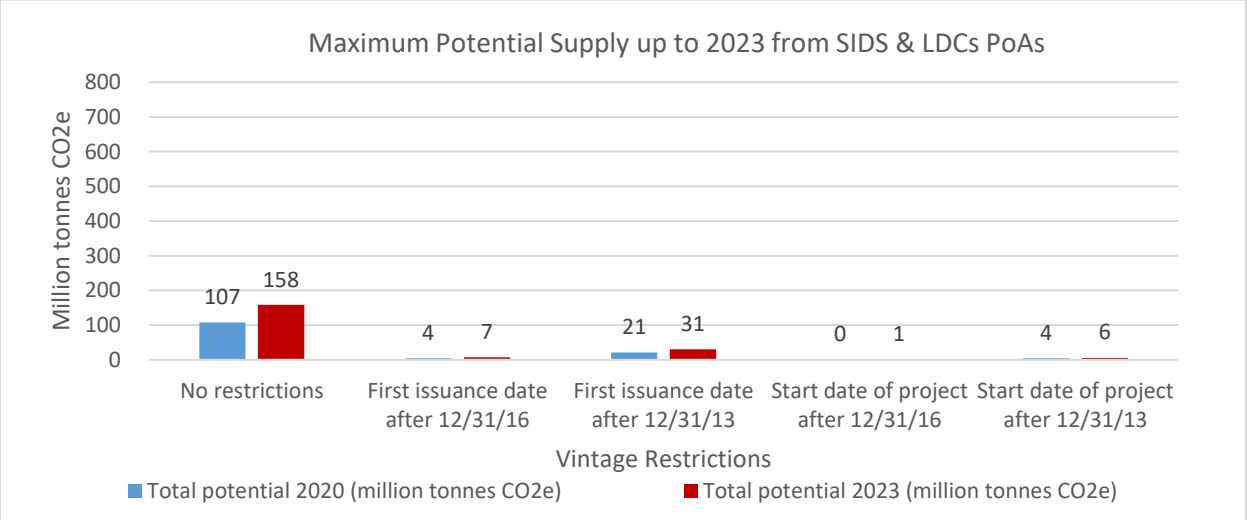


Figure 8 depicts maximum potential supply from PoAs in SIDS and LDCs. Under a PoA, it is possible to register the coordinated implementation of a policy, measure or goal that leads to emission reduction. Once a PoA is registered, an unlimited number of component project activities (CPAs) can be added without undergoing the complete CDM project cycle.[65] From the above figure, applying no vintage restriction on PoAs gives a pre-2020 maximum potential supply that is similar to the supply from CDM projects in SIDS and LDCs. Country restrictions help to

improve the likelihood of environmental benefits from CERs and prevents an overflow of offset credits into the CORSIA market or the PA Article 6.4 mechanism.

Figure 9. Total potential pre-2020 and pre-2023 supply of tonnes CO_2e from PoAs in SIDS, LDCs and the African Countries not categorized as LDCs.

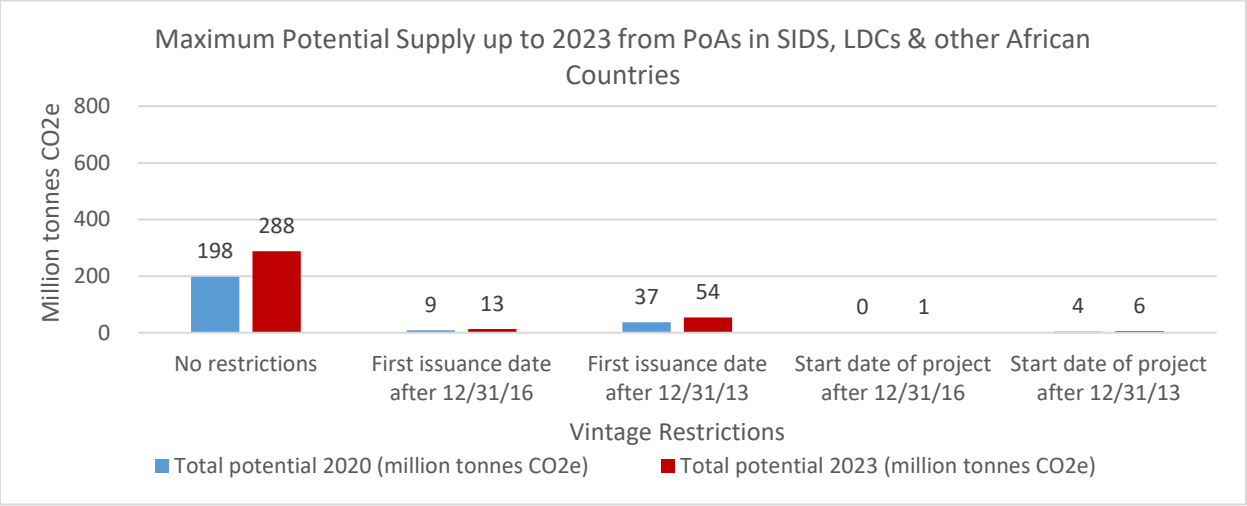


Figure 9 above builds on the previous figures as it depicts the maximum potential supply of tonnes of CO_2e that might be available with the inclusion of African countries not categorized as LDCs. Including African countries with CDM PoAs such as Ghana, Kenya and South Africa (among others) increases the maximum potential supply from CDM PoAs.

Figure 10. Total potential pre-2020 and pre-2023 supply of tonnes CO_2e from Projects and PoAs in SIDS&LDCs

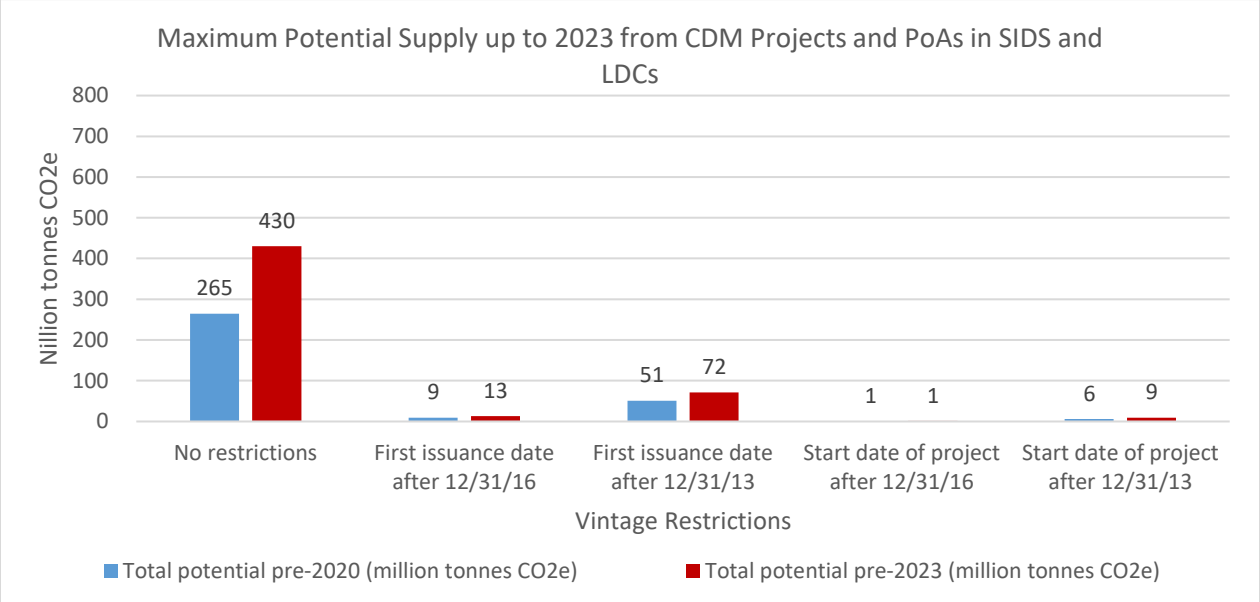
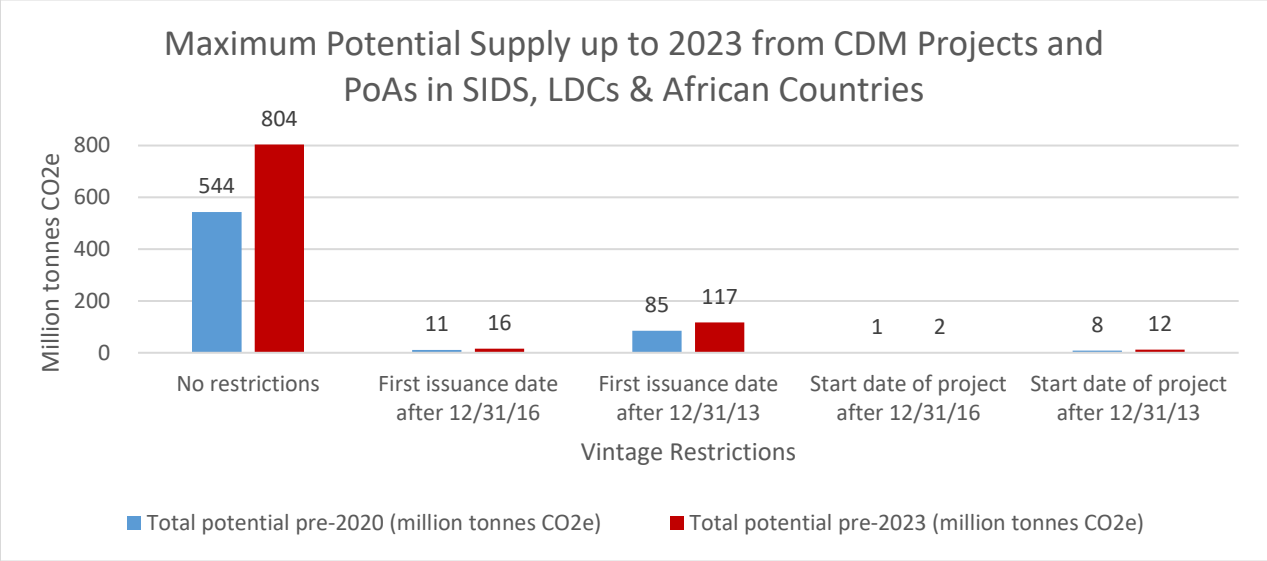


Figure 10 combines the information presented in Figures 4 and 7. If projects and PoAs from SIDS and LDCs only are authorized for use by participating airlines in the first three years of CORSIA, without any vintage restrictions, maximum potential supply without vintage restrictions exceeds

CORSIA demand by about 100 – 300 million tonnes of CO_2e. However, it is expected that issuance rates might greatly reduce these numbers, making actual volume of CERs much smaller than presented here.

Figure 11. Total potential pre-2020 and pre-2023 supply of tonnes CO2e from Projects and PoAs in SIDS, LDCs and other African Countries



Last, Figure 11 above combines the maximum potential supply of emissions reductions from CDM Projects and PoAs in SIDS, LDCs and other African countries not categorized as LDCs. It is important to note once again that issuance rates and incentive to register those unregistered projects may reduce the actual supply of CDM CERs from this group of countries. The projects in these countries are most likely to deliver real environmental benefits.

5. Conclusion

If the Parties to the KP were to make an amendment to the KP, authorizing the use of CERs for purposes other than those specified in the KP (i.e., to meet QELRCs and to foster sustainable development countries not in Annex I to the KP), and CERs from CDM projects and PoAs in SIDS and LDCs meet the CORSIA emissions units criteria developed by the ICAO Council and its technical Committee on Aviation Environmental Protection (CAEP), vintage restrictions would be necessary to ensure high-quality credits that promote environmental integrity for airlines. In the case of the Article 6.4 mechanism under the PA, Parties to the PA also have to consider anticipated demand and supply when deciding on the authorization of CERs for use under the PA. It is important that the Article 6.4 mechanism improves the CDM design to address the associated challenges described in this paper, including incentivizing projects that are truly additional, deliver an overall mitigation in global emissions, and promotes a market with a balanced supply and demand to allow financing for sustainable development and mitigation. SIDS and LDCs have not accessed the sustainable development benefits of the CDM under the KP on the scale that other larger developing countries were able to, despite their need. Furthermore, CDM projects and PoAs in SIDS, LDCs and from other African countries not categorized as LDCs are more vulnerable to discontinuation without support from market mechanisms, strengthening the case

for limiting use of CERs to those originating in SIDS and LDCs, provided that they satisfy quality and accounting standards, including the need to avoid double counting.

Appendix. Table 1. List of SIDS and LDCs with projects that are vulnerable to discontinuation.[66]

Region/Country for CDM projects (No. of projects)	Biomass energy	EE households	HFCs	Landfill gas	Methane avoidance	PFCs and SF6	Total
Caribbean	**6**	**0**	**0**	**3**	**0**	**0**	**9**
Bahamas	0	0	0	1	0	0	1
Barbados							0
Belize	0	0	0	1	0	0	1
Dominican Republic	5	0	0	1	0	0	6
Guyana	1	0	0	0	0	0	1
Haiti							0
Jamaica	0	0	0	0	0	0	0
Trinidad and Tobago							0
Asia & Pacific	**4**	**1**	**0**	**3**	**20**	**1**	**29**
Bangladesh	1	0	0	2	0	0	3
Bhutan	0	0	0	0	0	0	0
Cambodia	1	0	0	0	4	0	5
Fiji	0	0	0	0	1	0	1
Lao PDR	0	0	0	0	2	0	2
Myanmar	0	0	0	0	0	0	0
Nepal	0	1	0	0	4	0	5
Papua New Guinea	0	0	0	0	8	0	8
Singapore	2	0	0	1	1	1	5
Timor-Leste							0
Vanuatu							
Europe & Central Asia	**1**	**0**	**0**	**1**	**0**	**0**	**2**
Moldova	1	0	0	1	0	0	2
Africa	**8**	**13**	**0**	**15**	**4**	**0**	**40**
Algeria	0	0	0	0	0	0	0
Angola	0	0	0	0	0	0	0
Burkina Faso	0	0	0	0	0	0	0
Burundi	0	0	0	0	0	0	0
Chad							0

Cameroon	0	2	0	2	0	0	4
Cape Verde	0	0	0	0	0	0	0
Congo DR	0	0	0	1	0	0	1
Côte d'Ivoire	2	0	0	2	0	0	4
Djibouti							0
Equatorial Guinea							0
Ethiopia	0	0	0	1	1	0	2
Gabon							0
Gambia	0	1	0	0	0	0	1
Lesotho	0	1	0	0	0	0	1
Liberia	0	0	0	1	0	0	1
Madagascar	0	1	0	0	0	0	1
Malawi	0	2	0	0	0	0	2
Mali	0	0	0	0	0	0	0
Mauritius	0	0	0	1	0	0	1
Mozambique	0	1	0	0	0	0	1
Namibia	0	0	0	1	1	0	2
Niger	0	0	0	0	0	0	0
Rwanda	0	2	0	0	0	0	2
Senegal	2	0	0	1	0	0	3
Sierra Leone	1	0	0	0	0	0	1
Somalia							0
Sudan	0	0	0	1	0	0	1
Tanzania	1	0	0	1	0	0	2
Togo							0
Tunisia	1	0	0	2	0	0	3
Uganda	1	2	0	1	2	0	6
Zambia	0	1	0	0	0	0	1
Zimbabwe	0	0	0	0	0	0	0
Middle East	**0**	**1**	**0**	**0**	**0**	**0**	**1**
Yemen	0	1	0	0	0	0	1
Total	**19**	**15**	**0**	**22**	**24**	**1**	**81**

[1] See ICAO Resolution A39-3, text available at: https://www.icao.int/environmental-protection/Documents/Resolution_A39_3.pdf (accessed January 29 2018).
[2] "What is CORSIA and how does it work?," International Civil Aviation Organization, text available at: https://www.icao.int/environmental-protection/Pages/A39_CORSIA_FAQ2.aspx (accessed February 2 2018).

[3] "Why ICAO decided to develop a global MBM scheme for international aviation?," International Civil Aviation Organization, text available at: https://www.icao.int/environmental-protection/Pages/A39_CORSIA_FAQ1.aspx (accessed February 2 2018).
[4] See ICAO Assembly Working Paper A39-WP/55, text available at: https://www.icao.int/Meetings/a39/Documents/WP/wp_055_en.pdf (accessed February 2 2018).
[5] See List of Annex I parties to the Convention, available at: http://unfccc.int/parties_and_observers/parties/annex_i/items/2774.php (accessed February 2 2018).
[6] See Kyoto Protocol Article 12.2. See also Kyoto Protocol Article 3, 6.1 and Article 17. Text available at: http://unfccc.int/resource/docs/convkp/kpeng.pdf (accessed February 2 2018).
[7] See Paris Agreement, text available at: http://unfccc.int/files/essential_background/convention/application/pdf/english_paris_agreement.pdf (accessed January 31 2018).
[8] See Paris Agreement, Article 6.2 and 6.4, text available at: http://unfccc.int/files/essential_background/convention/application/pdf/english_paris_agreement.pdf (accessed February 2 2018).
[9] See Decision 1/CMA.1, text available at: http://unfccc.int/resource/docs/2016/cma1/eng/03a01.pdf and Decision 1/CP.22, text available at: http://unfccc.int/resource/docs/2016/cop22/eng/10a01.pdf (accessed February 2 2018)
[10] See ICAO News Release, ICAO Council reaches landmark decision on aviation emissions offsetting (2018), text available at: https://www.icao.int/Newsroom/Pages/ICAO-Council-reaches-landmark-decision-on-aviation-emissions-offsetting.aspx (accessed July 2, 2018)
[11] See Proposal for the First Edition of Annex 16, Volume IV, concerning Standards and Recommended Practices relating to the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA), text available at: https://www.transportenvironment.org/sites/te/files/publications/2018_01_ICAO_CORSIA_draft_%20SARP.pdf (accessed July 2 2018).
[12] See ICAO Resolution A39-3, text available at: https://www.icao.int/environmental-protection/Documents/Resolution_A39_3.pdf (accessed January 29 2018).
[13] Strand, Jon, and Knut Einar Rosendahl. "Global emissions effects of CDM projects with relative baselines." *Resource and Energy Economics* 34, no. 4 (2012): 533-48, (accessed February 2 2018). https://doi.org/10.1016/j.reseneeco.2012.05.003.
[14] See Decision 17/CP.7, text available at: http://unfccc.int/resource/docs/cop7/13a02.pdf#page=2 (accessed February 4 2018).
[15] Decision 3/CMP.1, text available at: http://unfccc.int/resource/docs/2005/cmp1/eng/08a01.pdf#page=30 (accessed February 2 2018).
[16] See Decision 7/CMP.1, text available at: http://unfccc.int/resource/docs/2005/cmp1/eng/08a01.pdf#page=93 (accessed February 2 2018).
[17] Mejia Giraldo, Camilo. "Panama's Barro Blanco Dam to Begin Operation, Indigenous Pleas Refused." *Mongabay* (2017) https://news.mongabay.com/2017/03/panamas-barro-blanco-dam-to-begin-operation-indigenous-pleas-refused/ (accessed July 3 2018).
[18] Michaelowa, Axel. "Strengths and weakness of the CDM in comparison with new and emerging market mechanisms." CDM Policy Dialogue (2012), text available at: http://www.cdmpolicydialogue.org/research/1030_strengths.pdf (accessed July 3 2018).
[19] See CDM Programmes of Activities, available at: https://cdm.unfccc.int/ProgrammeOfActivities/index.html (accessed February 2 2018).
[20] See CDM Programmes of Activities, available at: https://cdm.unfccc.int/ProgrammeOfActivities/index.html (accessed February 2 2018).
[21] See Decision 10/CP.7 paragraph 1, text available at: http://unfccc.int/resource/docs/cop7/13a01.pdf (accessed February 3 2018).
[22] Schneider, Lambert and La Hoz Theuer, Stephanie. "Using the Clean Development Mechanism for nationally determined contributions and international aviation – Assessment of impacts on global GHG emissions." *Stockholm Environment Institute* (2017), available at: https://www.sei-international.org/mediamanager/documents/SEI-PR-2017-Using-the-Clean-Development-Mechanism.pdf (accessed January 28 2018).

[23] Erickson, Peter, Michael Lazarus, and Randall Spalding-Fecher. "Net climate change mitigation of the Clean Development Mechanism." *Energy Policy* 72 (2014): 146-54. https://doi.org/10.1016/j.enpol.2014.04.038 (accessed February 2 2018).
[24] Strand, Jon, and Knut Einar Rosendahl. "Global emissions effects of CDM projects with relative baselines." *Resource and Energy Economics* 34, no. 4 (2012): 533-48, https://doi.org/10.1016/j.reseneeco.2012.05.003 (accessed February 2 2018).
[25] See Fearnside, P., "Tropical Hydropower in the Clean Development Mechanism: Brazil's Santo Antônio Dam as an example of the need for change", *Climatic Change* (2015) 131:575–589. https://link.springer.com/article/10.1007/s10584-015-1393-3 (accessed January 29 2018); and see EDF, IDESAM, ISA et al., "Brazil's Amazon Hydroelectrics in the United Nations Clean Development Mechanism (CDM): Defrauding Investors, Cheating the Atmosphere?" (2017), text available at: http://www.edf.org/sites/default/files/brazil_cdm_report.pdf (accessed January 29 2018).
[26] Schneider, Lambert Richard. "Perverse incentives under the CDM: an evaluation of HFC-23 destruction projects." *Climate Policy* 11, no. 2 (2011): 851-64 https://doi.org/10.3763/cpol.2010.0096 (accessed January 29 2018).
[27] See AM0019 CDM Methodology, text available at: https://cdm.unfccc.int/methodologies/DB/7FFSYZXS2CQHL2051XI5QBASYNZ2RF (accessed February 2 2018).
[28] Petsonk, Annie and Carey, Melissa. "Clean Development Mechanism Rules of Procedure: Standards for the Executive Board and Operational Entities." Environmental Defense Fund (2002), available at: http://www.edf.org/sites/default/files/clean-development-mechanism-rules-procedure.pdf (accessed February 2 2018).
[29] Strand, Jon, and Knut Einar Rosendahl. "Global emissions effects of CDM projects with relative baselines." *Resource and Energy Economics* 34, no. 4 (2012): 533-48, (accessed February 2 2018). https://doi.org/10.1016/j.reseneeco.2012.05.003.
[30] Schneider, Lambert Richard. "Perverse incentives under the CDM: an evaluation of HFC-23 destruction projects." *Climate Policy* 11, no. 2 (2011): 851-64 (accessed January 29 2018) https://doi.org/10.3763/cpol.2010.0096.
[31] "Brazil's Amazon Hydroelectrics in the United Nations Clean Development Mechanism (CDM): Defrauding Investors, Cheating the Atmosphere?" Available at:: http://www.edf.org/sites/default/files/brazil_cdm_report.pdf (accessed Feb 5 2018).
[32] Agbonifo, Philip. "The Pursuit of Climate Protection And The Uneven Global Distribution of Clean Development Mechanism (CDM) Projects: Lesson From Least Developed Countries (LDCS)." *European Journal of Sustainable Development* 6, no.1 (2017): 135-152. Doi: 10.14207/ejsd.2017.v6n1p139 (accessed January 29 2018).
[33] UNEP DTU Partnership. "CDM Projects by host region." Available at: http://www.cdmpipeline.org/cdm-projects-region.htm (accessed February 4 2018).
[34] UNEP DTU Partnership. Available at: http://www.cdmpipeline.org/cers.htm#3 (accessed January 21 2018).
[35] See Ruthner et al. "Study on the integrity of the clean development mechanism (CDM)."AEA (2011), text available at: https://ec.europa.eu/clima/sites/clima/files/ets/markets/docs/final_report_en_0.pdf (accessed February 5 2018).
[36] See Decision 3/CMP.1, Annex, text available at: http://unfccc.int/resource/docs/2005/cmp1/eng/08a01.pdf#page=30 (accessed February 6 2018).
[37] See Decision 3/CMP.1, Appendix D, paragraphs 1 and 9, text available at: http://unfccc.int/resource/docs/2005/cmp1/eng/08a01.pdf#page=30 (accessed February 6 2018).
[38] See Doha amendment to the Kyoto Protocol, text available at: http://unfccc.int/files/kyoto_protocol/application/pdf/kp_doha_amendment_english.pdf (accessed February 4 2018).
[39] Decision 1/CMP.8, para 13: "Clarifies also that for the purposes of the second commitment period, from 1 January 2013 onwards, a Party included in Annex I may continue to participate in ongoing project activities under Article 12 and in any project activities to be registered after 31 December 2012, but only a Party with a quantified emission limitation and reduction commitment inscribed in the third column of Annex B as contained in annex I to this decision shall be eligible to transfer and acquire certified emission reductions (CERs) in accordance with decision 3/CMP.1 and with paragraph 15 below." text available at: http://unfccc.int/resource/docs/2012/cmp8/eng/13a01.pdf (accessed January 28 2018).

[40] See: Cames, Martin et al. "How Additional is the Clean Development Mechanism." *Oeko Institute* (2016), text available at: https://ec.europa.eu/clima/sites/clima/files/ets/docs/clean_dev_mechanism_en.pdf (accessed February 3 2018).
[41] See Schneider, Lambert and La Hoz Theuer, Stephanie. "Using the Clean Development Mechanism for nationally determined contributions and international aviation – Assessment of impacts on global GHG emissions." *Stockholm Environment Institute* (2017), available at: https://www.sei-international.org/mediamanager/documents/SEI-PR-2017-Using-the-Clean-Development-Mechanism.pdf (accessed January 28 2018).
[42] Warnecke, C., Day, T., & Fearnehough, H. Marginal cost of CER supply and implications of demand sources. (2018), Available at: https://www.dehst.de/SharedDocs/downloads/EN/project-mechanisms/Marginal-cost-of-CER-supply.pdf?__blob=publicationFile&v=1 (accessed Mar 20 2018).
[43] Warnecke, C., Day, T., & Fearnehough, H. Marginal cost of CER supply and implications of demand sources. (2018), Available at: https://www.dehst.de/SharedDocs/downloads/EN/project-mechanisms/Marginal-cost-of-CER-supply.pdf?__blob=publicationFile&v=1 (accessed Mar 20 2018).
[44] Castro, Paula and Michaelowa, A. "Empirical Analysis of Performance of CDM Projects." *Climate Strategies*, text available at: http://www.indiaenvironmentportal.org.in/files/empirical-done.pdf
[45] Warnecke, C., Day, T., & Tewari, R. "Impacts of the Clean Development Mechanism." *New Climate Institute* (2015), Available at: http://newclimate.org/2015/11/30/impacts-of-the-clean-development-mechanism/
[46] World Bank, Ecofys, & Vivid Economics. "State and Trends of Carbon Pricing 2016." Available at: https://doi.org/10.1596/978-1-4648-1001-5
[47] See https://www.edf.org/climate/icaos-market-based-measure (accessed March 23, 2018).
[48] See Nurse et al., "Small Islands" in *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects.* Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, (Cambridge and New York: Cambridge University Press, 2014) 1613-165, available at: https://www.ipcc.ch/pdf/assessment-report/ar5/wg2/WGIIAR5-Chap29_FINAL.pdf (accessed February 4 2018).
[49] See "Improving Access to Climate Finance for Small and Vulnerable States. A Report of the Commonwealth Expert Group on Climate Finance to the Commonwealth Heads of Government Meeting 2013." (2013), Available at: http://thecommonwealth.org/sites/default/files/news-items/documents/Report%20of%20the%20Commonwealth%20Expert%20Group%20on%20Climate%20Finance.pdf (accessed February 3 2018).
[50] See e.g. Warnecke, Carsten et al., "Vulnerability of CDM Projects for Discontinuation of Mitigation Activities Assessment of Project Vulnerability and Options to Support Continued Mitigation." (2017). *German Emissions Trading Authority*. Available at: https://newclimate.org/wp-content/uploads/2017/05/vulnerability-of-cdm.pdf (accessed February 3 2018).
[51] See e.g. Warnecke, Carsten et al., "Vulnerability of CDM Projects for Discontinuation of Mitigation Activities Assessment of Project Vulnerability and Options to Support Continued Mitigation." (2017). *German Emissions Trading Authority*. Available at: https://newclimate.org/wp-content/uploads/2017/05/vulnerability-of-cdm.pdf (accessed February 3 2018).
[52] Climate Focus Client Brief on the Paris Agreement II, Double Counting in the Paris Agreement (2016), text available at: http://www.climatefocus.com/sites/default/files/20160105%20-v.2.0%20Double%20Counting%20and%20Paris%20Agreement%20FIN.pdf.pdf (accessed March 25 2018).
[53] See Paris Agreement, Article 4.13 and Article 6.2, text available at: http://unfccc.int/files/essential_background/convention/application/pdf/english_paris_agreement.pdf; see also ICAO CORSIA draft SARPs, text available at: http://icsa-aviation.org/wp-content/uploads/2018/01/ICAO_CORSIA_draft_-SARP.pdf (accessed February 2 2018)
[54] Paris Agreement, Article 4.13, text available at: http://unfccc.int/files/essential_background/convention/application/pdf/english_paris_agreement.pdf (accessed February 2 2018).
[55] ICAO CORSIA draft SARPs, text available at: http://icsa-aviation.org/wp-content/uploads/2018/01/ICAO_CORSIA_draft_-SARP.pdf (accessed February 2 2018)
[56] Office of the High Representative for the Least Developed Countries, Landlocked Developing Countries and Small Island Developing States (UN-ORHLLS). Small Island Developing States in Numbers (2015),

text available at: https://sustainabledevelopment.un.org/content/documents/2189SIDS-IN-NUMBERS-CLIMATE-CHANGE-EDITION_2015.pdf (accessed March 23 2018).

[57] See Submission to the Articles 6.2 and 6.4 of the Paris Agreement by the Republic of Maldives on behalf the Alliance of Small Island States (2017), text available at: http://www4.unfccc.int/Submissions/Lists/OSPSubmissionUpload/167_317_131382181838031501-AOSIS_Submission_Art%206%202%20and%206%204%20of%20%20PA.27.04.2017.FINAL.pdf (accessed March 28 2018).

[58] Leslie, Gabriela. "Global Emissions Within and Outside the Scope of Nationally Determined Contributions. A Preliminary Analysis of "Double Counting" Risks for Internationally Transferred Mitigation Outcomes." (2018) *Environmental Defense Fund*. Available at: https://www.edf.org/sites/default/files/documents/EDF_NDC%20Emissions%20Coverage%20Analysis.pdf?_ga=2.203603728.1239001147.1530610788-362881355.1469466910] (accessed July 5 2018)

[59] See e.g. "How to count these credits." Available at: http://www.nationalecocredit.com/en/le-marche-du-carbone/le-principe-du-marche-du-carbone/comment-comptabiliser-ces-credits-de-carbone/ (accessed February 3 2018).

[60] Schneider, Lambert and La Hoz Theuer, Stephanie. "Using the Clean Development Mechanism for nationally determined contributions and international aviation – Assessment of impacts on global GHG emissions." *Stockholm Environment Institute* (2017), available at: https://www.sei-international.org/mediamanager/documents/SEI-PR-2017-Using-the-Clean-Development-Mechanism.pdf (accessed January 28 2018).

[61] Schneider, Lambert and La Hoz Theuer, Stephanie. "Using the Clean Development Mechanism for nationally determined contributions and international aviation – Assessment of impacts on global GHG emissions." *Stockholm Environment Institute* (2017), available at: https://www.sei-international.org/mediamanager/documents/SEI-PR-2017-Using-the-Clean-Development-Mechanism.pdf (accessed January 28 2018).

[62] Decision 6/CMP.11 paragraphs 4, 7, and 3/CMP.12.

[63] https://www.edf.org/climate/icaos-market-based-measure (accessed March 23, 2018).

[64] Schneider, Lambert and La Hoz Theuer, Stephanie. "Using the Clean Development Mechanism for nationally determined contributions and international aviation – Assessment of impacts on global GHG emissions." *Stockholm Environment Institute* (2017), available at: https://www.sei-international.org/mediamanager/documents/SEI-PR-2017-Using-the-Clean-Development-Mechanism.pdf (accessed January 28 2018).

[65] See CDM Programmes of Activities, available at: https://cdm.unfccc.int/ProgrammeOfActivities/index.html (accessed February 4 2018)

[66] See e.g. Warnecke, Carsten et al., "Vulnerability of CDM Projects for Discontinuation of Mitigation Activities Assessment of Project Vulnerability and Options to Support Continued Mitigation." (2017). *German Emissions Trading Authority*. Available at: https://newclimate.org/wp-content/uploads/2017/05/vulnerability-of-cdm.pdf (accessed February 3 2018).