LIFE DICET

Emissions trading systems with different offsets provisions: implications for linking

Report for the Carbon Market Policy Dialogue

Authors: Giulio Galdi, Stefano F. Verde, Simone Borghesi, Jürg Füssler, Ted Jamieson, Martin Soini, Emily Wimberger and Li Zhou

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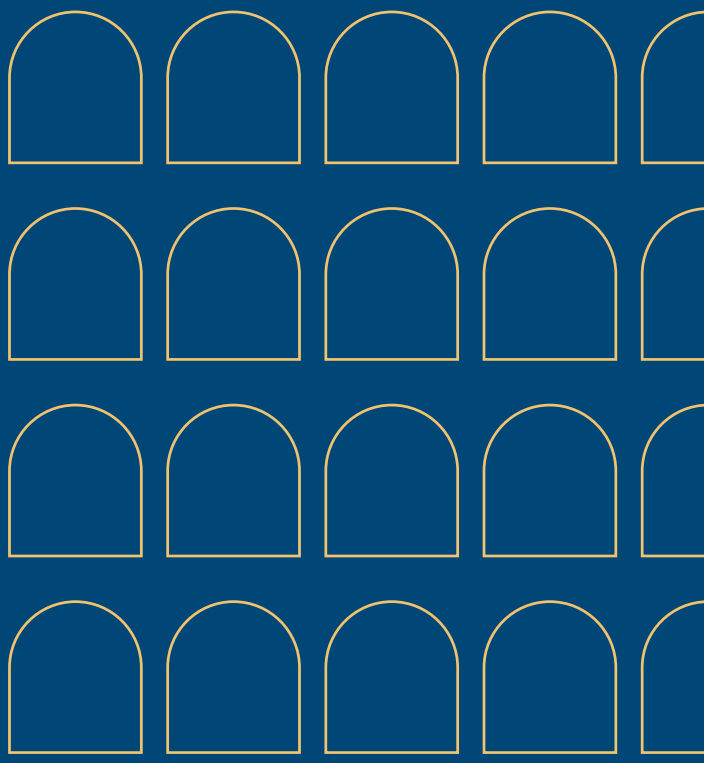

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ROBERT SCHUMAN CENTRE

Requests should be addressed to fsr@eui.eu.
Florence School of Regulation
Robert Schuman Centre for Advanced Studies

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1. Introduction

At the time of writing (June 2021), most emissions trading systems (ETSs) around the world are experiencing a positive momentum: allowance prices are on the rise and carbon markets are attracting participation from financial operators. While high allowance prices are generally the sign of a stringent and, therefore, working ETS, very high prices pose at least two types of problems: one is the risk of crumbling political support for the ETS; the other concerns the possibility that, outside the ETS (whether in the same jurisdiction or not), much cheaper emissions abatement options are unexploited. In theory, the use of emission offsets, i.e. the use of emission credits for offsetting emissions, offers a solution to the second issue, as it allows for emissions abatement within the ETS to be replaced by cheaper abatement outside[1]. In this sense, the use of offsets offers efficiency gains that are similar to those achievable by linking ETSs with different abatement costs. Moreover, as cheaper abatement opportunities tend to be concentrated in less developed economies, emission offsets provide a platform for international cooperation that involves those. In practice, however, the experience with emission offsetting has so far been mixed or even controversial.

The first experience of ETSs with emission offsetting is related to the Kyoto Protocol's 'flexible mechanisms', namely the Clean Development Mechanism (CDM) and the Joint Implementation (JI). The basic difference between the two mechanisms is in whether the country hosting the project that generates emission credits is a developing country (CDM) or an industrialised one (JI). Again, while in theory the use of offsets in ETSs was meant to enhance cost-effectiveness in emission abatement, reality often turned out to be different. In the case of the EU ETS, major inflows of emission credits from the CDM and the JI, de facto raised the cap on regulated emissions. This aggravated a market imbalance that was mainly due to the effects of the Great Recession (2007-2009), thus further depressing allowance prices and undermining the cost-effectiveness of the system over the long term. Furthermore, credits generated by the CDM and the JI were riddled with doubts about their environmental integrity, that is, their ability to represent real, permanent, additional, and verifiable emission abatement (see, e.g., Cames et al., 2016; Kuriyama and Abe, 2018; Schneider, 2003; Mason and Plantinga, 2013). Also, while not directly relevant to the functioning of an ETS, many projects that generated emission credits came under the spotlight for alleged violations of human rights (see, e.g., Schade and Obergassel, 2014).

Of the six ETSs involved in the Carbon Market Policy Dialogue (CMPD) (namely, the EU ETS and the ETSs of California, China, New Zealand, Quebec, and Switzerland), all have some form of qualitative or quantitative restrictions in force. In the EU ETS, in response to persistent excess supply and environmental integrity concerns, the use of offsets was first restricted and then completely shut down. In the NZ ETS, all international offsets are excluded. Offsets have not altogether vanished, however – far from it. Not only do most ETSs admit regulated use of emission offsets, but there is also a general expectation that offsets will play a greater role in their future and in the future of climate mitigation more generally. Increasingly ambitious emission abatement targets will likely strengthen incentives for using emission offsets and, in this connection, the future rules operationalising Article 6 of the Paris Agreement will be important.

Against this background, the present report reviews the literature on offsets, with a focus on the implications of different offsetting rules for hypothetical linkages between ETSs, and summarises the relevant recent developments in each of the six ETSs involved in the CMPD.

1 While emission 'credit' refers to the achievement of a mitigation outcome, emission 'offset' refers to the use of a credit for compensating emissions.

2. Conceptual framework

In this section we briefly illustrate the most relevant issues concerning offsets and their use in the context of an ETS. A more in-depth analysis of these issues, including the implications for ETS linking, is offered in the subsequent sections.

2.1 Limits on the use of offsets

Offsets provisions in an ETS may include limits of a qualitative or quantitative nature, or both. Quantitative limits enforce a maximum number of offsets/credits that can be used for compliance. They are typically implemented in the form of a maximum share of emissions that a regulated firm or installation is allowed to cover with offsets, instead of allowances. Alternatively, quantitative restrictions may be expressed in terms of a maximum share of an overall emission reduction target that can be achieved with offsets (see, for example, the cases of the EU ETS and Switzerland's ETS described in section 4). Qualitative limits, by contrast, do not impose a quantitative ceiling on the use of offsets. Rather, they restrict the types of activities that can generate eligible credits. ETS regulators may decide to accept credits only from certain specific activities or, more simply, they may prefer to exclude certain activities. Other restrictions could concern the geographical scope of the projects (e.g. international vs domestic) or the time of generation of the credits (e.g. the compliance period of the Kyoto Protocol). In an ETS, offset provisions typically include both qualitative and quantitative limitations.

2.2 Challenges and opportunities of offsets

The use of offsets in emissions trading has a somewhat controversial history. This is mainly due to doubts as to the actual abatement underlying different types of emission credits. While many ETS regulators have imposed limits on the use of offsets, these still account for a non-negligible share of compliance in some ETSs. For instance, the Californian ETS allows operators to use offsets to cover up to 8% of their emissions. Indeed, the limits on offsets did not represent a lack of interest, but rather concerns about the governance and environmental integrity of some offsets, notably some Certified Emission Reductions (CERs) issued under the CDM. In general, the interest in offsets transcends economic efficiency considerations as there are also other potential benefits that offsets may offer. In the following, we outline the main issues concerning the implementation and the use of offsets under an ETS.

Environmental integrity

One of the main criticisms towards the use of emission offsets concerns the credibility of the underlying emission abatement, or, in other words, the environmental integrity of the credits/offsets. If there is any uncertainty on whether a credited tonne of CO_2 was actually abated by the originating project, the environmental value (and possibly also the market value) of the credit is compromised. If no or only partial abatement was actually achieved by the project that generated an emission credit and, yet, the same credit gave a firm the right to emit an additional tonne of CO_2, then clearly the offsetting system would cause an increase in overall emissions. The credibility of an emission credit rests on the following four qualities (Santikarn et al., 2018):

- Reality: For an offset to be credible, it should certify mitigation efforts that have already occurred, rather than prospective ones.
- Additionality: In order to claim to have effectively abated emissions, credits need to derive from additional abatement efforts. Accordingly, project developers should be able to prove that the abatement would not have occurred without the additional finance attracted through the issuance of the carbon credit. Therefore, an abatement is not additional if it is a consequence of any action that was, for instance, part of the plans of a national regulator or firm. To this end, a baseline scenario of emissions and foreseen mitigation actions serves as a point of reference. An abatement would then be additional if it reduces emissions with respect to the baseline scenario.
- Measurability: The mitigation effort that yields an emission credit should be quantifiable and

verified. Also, to ensure transparency, verification of abatement should be performed by an independent entity, rather than by the project developer or by the government of the country hosting the project.

- Permanence: Depending on the nature of the offset project, the emission abatement originally achieved could be subsequently reversed, for example by a natural event. An obvious example is an afforestation project whose CO_2 removal is then reversed by a forest fire.

If a credit lacked one or more of these qualities, its actual abatement value would be doubtful. Therefore, if an ETS allowed the use of such credits for offsetting purposes, the environmental integrity of the ETS itself would be compromised.

Diversion of mitigation efforts

Independent of whether offset projects are domestic (i.e. located in the same jurisdiction as the ETS) or international (i.e. hosted in a foreign jurisdiction), they may discourage policy interventions. If a new or tighter climate policy would have been implemented in the baseline scenario (i.e. if the project had not existed), but it is instead delayed or suspended because of the project and its generation of emission credits, overall emissions may turn out to be higher than in the baseline scenario. For instance, a project aimed at decarbonising energy supply by deploying renewable energy technologies (e.g. wind turbines) could disincentivise further policy action and ultimately lead to higher emissions. Moreover, relying on offsetting as a strategy to lower compliance costs within an ETS may result in postponing investments in low-carbon technologies, by firms or countries, and thus increase long-term transition costs (de Alegría *et al.*, 2017). The continuation of the technological and socio-economic infrastructure that supports existing, more carbon-intensive technologies may induce carbon lock-in: a state of inertia of the economic system that makes structural changes more expensive or difficult (Unruh, 2000).

Collateral risks and co-benefits

As offsets projects are developed in a geographical, socioeconomic, and institutional context, they are also bound to have broader effects on the country and the community in which they are located. On the one hand, some communities have contested that the implementation of the projects worsened their life conditions in several respects including gender issues, inequality, and human rights violations. On the other, offset projects may also bring relevant co-benefits to the communities they affect. Their implementation may create employment and thus contribute to poverty alleviation, while also potentially improving the health and the environmental quality of the territory.

Cost-effectiveness potential

Last but not least, it should be remarked that offsets have the potential to deliver sizable reductions in compliance costs under ETSs and, more in general, to enhance cost-effectiveness of mitigation actions. Indeed, as argued in the introduction, emission offsets allow for the exploitation of cheaper mitigation alternatives, thus minimising the cost of abating a given amount of emissions. Against the background of the Nationally Determined Contributions (NDCs) pledged under the Paris Agreement, which will require an increase in the climate ambition of policy frameworks in all countries, it is easy to see how the cost-effectiveness of mitigation actions will constitute a treasurable quality. By reducing the cost of mitigation for a country, offsets may increase the likelihood that that country can fulfil its pledge or even pursue a more ambitious one.

2.3 Interactions with the Paris Agreement

The use of offsets in the future, especially in the context of an ETS, will critically depend on the rules that will be agreed for operationalising Article 6 of the Paris Agreement, that is, the specific rules of the new emerging global carbon market.

Signed in 2015, the Paris Agreement is an international agreement under which all signatory countries pledge to achieve a Nationally Determined Contribution (NDC) to halt climate change and to limit

the global temperature increase to well below 2°C above pre-industrial levels, with determined efforts to stay below 1.5°C. The progress in mitigation efforts is regularly assessed at Global Stocktakes, the first of which is planned to take place in 2023 and which will inform the next round of NDC pledges. The parties to the Paris Agreement have a legally-binding obligation to present their NDC, but their fulfilment is not binding. This means that countries do not face direct negative consequences from failing to meet their pledged NDC. Signatory countries can present a double pledge too. They can specify whether the pledged target will be reached relying on international climate finance or global mitigation efforts ('conditional NDC'), or independent of them ('unconditional NDC'). The conditional NDCs are, thus, more ambitious and they include further mitigation actions that need enhanced cooperation to be enacted. Among the cooperation mechanisms present in the Paris Agreement, Article 6.2 allows parties to exchange 'internationally transferred mitigation outcomes' (ITMOs) in pursuit of their NDCs. Similarly, Article 6.4 establishes a crediting mechanism for emission reductions which can be described as the new and expectedly improved version of the Kyoto Protocol's CDM. The first mechanism, under Article 6.2, is largely conducted and authorised by the Parties participating in the transaction, whereas the second relies on supervision by a supranational body. Article 6 also specifies that a share of the proceeds are to finance administrative expenses and to support developing countries in their mitigation efforts. The details of how ITMOs are defined, how they are exchanged, the standards for ensuring the environmental integrity of the mechanisms, and the composition and governance of the supranational body will be contained in the Article 6 rulebook. This is to be discussed at the next annual meeting of the Conference of the Parties (COP), in Glasgow, in November 2021.

While the word 'market' does not even appear explicitly in the text of the Paris Agreement, ETS linking is one key application of the voluntary exchange of ITMOs under Article 6.2. Moreover, linked ETSs may be affected by the Paris Agreement if one or more of the linked jurisdictions establish some degree of interchangeability between their own emission allowances and the ITMOs. We have identified three channels of interactions between ETS linkages and the Paris Agreement:

- Double counting: In order to preserve the environmental integrity of ETSs, it is important to establish a robust emissions accounting method. In particular, instances of double counting must be avoided, that is the claim by multiple entities (either firms or countries) for the same mitigation outcome. If one jurisdiction in a linkage were to use credits deriving from offsets that are counted by more than one entity, the environmental integrity of the linked market would be compromised.

- Target setting: Lowering the cap of an ETS (one with a cap) is the canonical approach for increasing its environmental ambition. However, in theory, if one jurisdiction in a linkage were to sell its allowances as ITMOs, the price on the international carbon market could discourage the policymakers from decreasing the cap in the future. To the extent that this limits the convergence in environmental ambition with other ETSs, this might constitute an obstacle to a linkage (Verde et al., 2020).

- ITMOs as compliance units: At the time of writing, the nature of the ITMOs is still not perfectly defined. On the one hand, some countries propose that ITMOs serve to keep track of net flows between countries exchanging mitigation outcomes. On the other hand, other countries advocate that ITMOs should be issued to specific registries, much like the Assigned Amount Units under the Kyoto Protocol. Furthermore, it is still unclear how they will be measured, and the option to use tonnes of CO_2 as a metric is still on the table, greatly facilitating an equivalence with allowances from ETSs (Schneider *et al.*, 2018). In this scenario, one regulator in a linkage might decide to accept ITMOs as compliance units. Even if one or more linking partners decided not to do the same, the effective cap on the linked market is increased, as allowances from the jurisdictions accepting ITMOs as compliance units would be "freed up" to be sold to firms in partner jurisdictions. As any measure that could allow one partner to unilaterally affect the cap, the question of whether and to what extent to accept ITMOs as compliance units should be agreed by prospective linking partners.

3. Literature review

The literature on the interactions between offset provisions and ETS linking in particular is quite thin. We focus on past experiences with offsets and provide insights into plausible future developments in offsets and, more generally, in the trading of mitigation outcomes under the Paris Agreement.

3.1 Missteps in carbon offsetting

Experiences with offsets come mainly from the Clean Development Mechanism (CDM) established by the Kyoto Protocol. But some ETSs around the world have also admitted the use of credits coming from mechanisms other than the CDM. We here briefly review the problems that arose in the past with emission offsets use and the relative insights that may be drawn.

Environmental integrity and diversion of mitigation efforts

The main criticism towards CDM credits in relation to an ETS concerns their environmental integrity, that is, the equivalence of the amount of CO_2 mitigated by the offsets projects to the additional polluting rights granted under an ETS. In a much cited report, Cames et al. (2016) note that only 2% of the projects that they reviewed, and 7% of the corresponding credits supply, had a high likelihood of bringing about actual (i.e. additional) emission reductions. For most projects with a low additionality score, emission credits funding covered only a minor part of the necessary funding, casting doubts on the assumption that investments would not have been made without the implementation of the offsets projects. By contrast, the costs of hydrofluorocarbons (HFC) destruction were found to be generally low and were largely covered by crediting. While scholars found that perverse economic incentives actually led to increased production in these industrial gasses (Schneider and Kollmuss, 2015; Haya et al., 2020; Schneider, 2011), once these concerns were adequately addressed in a later version of CDM methodology, mitigation from HFC projects was deemed additional with high likelihood (Cames et al., 2016).

Another criterion used to assess the additionality of an offset project is the level of emissions as compared to a baseline scenario. A problem with this approach is that if the project developer can influence the baseline to apply, she has an incentive to inflate the baselines so as to artificially increase the estimated volume of abated emissions (Michaelowa, 2012; Lazarus and Chandler, 2011; du Monceau and Brohé, 2011). Similarly, to attract more international finance in their jurisdiction, policymakers might also attempt to influence the baseline to be applied. Indeed, depending on how additionality is measured, policymakers may be able to alter the additionality status of projects in order to attract more international finance (Dulaney et al., 2017; He and Morse, 2013). Even without affecting baselines, policymakers might find themselves influencing project implementation, shying away from mitigation policies in sectors where offsets projects are developed, in order not to discontinue international funding. The decision of the US not to regulate federal methane emissions from coal mines could have been influenced by the role of these emissions in creating opportunities for cheap offsets for California's ETS (Haya et al., 2020). A similar concern affects the aforementioned HFC destruction projects, as their relatively low costs makes crediting very profitable, thus discouraging policy action (Cames et al., 2016). Developing countries are particularly exposed to the risk of reduced mitigation efforts as a consequence of offsets project implementation. Indeed, projects in developing countries increase their marginal abatement costs, inducing them to reduce their own mitigation efforts. Empirical evidence on CDM projects supports this hypothesis, thus pointing to the need for enhanced benefits for developing countries Stahlke, 2020). These examples show how assessing the additionality of offsets proves a challenge because of the lack of counterfactual action by policymakers.

Finally, it should be noted that emission offsets may also suffer from carbon leakage, that is, the phenomenon by which a given reduction in emissions delivered by a policy is at least partly compensated by an increase in emissions in another place, time, or sector. In the context of offsets, carbon leakage may be either direct or indirect. Direct carbon leakage occurs whenever emissions result from the implementation of the offsets project itself. In an example concerning the substitution of cropping land use with pasture, scholars highlighted that carbon leakage from the activities deriving from the usage of the

pasture might increase carbon emissions with respect to the baseline scenario (Thamo and Pannell, 2016). Indirect carbon leakage may also derive from market effects, whenever demand for a relatively more carbon-intensive product increases as a consequence of the offset projects. For example, forest projects might be exposed to indirect carbon leakage insofar as they induce an increase in demand for imported wooden products, thus likely increasing deforestation elsewhere (Haya, 2019).

Human rights and gender equality

Even emission offsets with the highest environmental integrity may (and have) become politically contentious due to their implications for human rights and gender equality. The human rights implications of CDM projects deployment are underrepresented in the scientific literature compared to other aspects of offsets; most evidence relating to these areas was gathered and published by NGOs and civil society organisations (Schade and Obergassel, 2014). Case studies illustrate how hydropower projects benefiting from carbon crediting finance have been forcefully implemented to the detriment of the local population. The communities of Naso and Ngobe hit international headlines when they sued the Panamanian government over the construction of the dams for a hydroelectric power generation project (Finley-Brook and Thomas, 2010). Members of indigenous communities residing at the project sites were reportedly swindled and pressured into selling off their land to project developers. They were resettled without consent, and protestors at the dam construction sites, including women and children, were beaten and arrested by the police (Finley-Brook and Thomas, 2010; Ananya, 2009; Barber, 2008; Jordàn, 2008; Cultural Survival, 2007). Further pressure strategies were allegedly executed, as testified by the Ngobe community during a court hearing. These included unwarranted house-to-house searches, death threats, and the destruction of property (Bird, 2013; Finley-Brook and Thomas, 2010; IACHR, 2009). In other case studies, protestors also reported physical violence (kidnappings, torture, sexual abuse). Armed confrontations between public and private security forces and locals, who were protesting the illegal confiscation of their land, were recorded in other instances, and also resulted in deaths (Schade and Obergassel, 2014; Bird, 2013; FIDH et al., 2011; Frank, 2011; CDM Watch, 2011).

While countries hosting projects that generate emission credits are responsible for ensuring that the projects do not involve any human rights violations (Schade and Obergassel, 2014), no provisions that directly address human rights were included in the CDM framework. Nor are there any strong international guarantees that projects implemented in violation of human rights will not be credited with valid credits. This delay was also due to some developing countries refusing to attach human rights standards to credit generation, claiming that it would violate their national sovereignty (Schade and Obergassel, 2014; Yamin and Depledge, 2004). The experiences illustrated above serve to show the importance that needs to be given in the Paris Agreement framework to clear human rights standards and the procedures to include them into emission crediting mechanisms. As argued by Schade and Obergassel (2014) and Cournil et al. (2012), in order to guarantee that no human rights violation underlies emission credits, it is essential that projects are eligible to issue credits only once they have undergone a Human Rights Impact Assessment (HRIA). It is relevant to remark here that the preamble of the Paris Agreement stresses that “Parties should, when taking action to address climate change, respect, promote and consider their respective obligations on human rights”. Detailed standards and procedures are, however, to be written in the Paris Rulebook.

Offsets projects may also have implications for gender equality by affecting (positively or negatively) women. For instance, cookstove projects are presented as being capable of generating sizable economic and time savings for women, allowing them to focus on other economic or care activities. The same projects, however, have been criticised too, as they might consolidate the traditional roles of women in society, rather than increasing their leverage within said societies and their families (Lehman, 2019). In general, while women are recognised as being disproportionately exposed to climate change, their role as agents of change for scaling up climate mitigation activities is often overlooked (Glemarec et al., 2016). Offsetting projects have the potential to increase the economic independence of women and to reduce their burden of care work. But clear guidelines would be needed to secure the gender equality co-benefits in all projects (UNDP, 2011). In order to empower women, gender equality perspectives should be streamlined across the whole process of the financing of mitigation activities, including the supply chains and employment involved (Glemarec et al., 2016; UNDP, 2011). Furthermore, to increase

the direct participation of women in mitigation projects, gender-biased procedural obstacles should be identified and removed. To foster the development of gender-sensitive offsetting projects, jurisdictions might also explicitly include gender equality requirements for credits admitted under their ETS (UNDP, 2011). Gender equality remains difficult to assess for its pervasiveness in the life of women. However, dedicated emission offsets standards have been recently developed and their demand is increasing in the voluntary carbon market (WOCAN, 2021).

Foregone economic and health co-benefits

Focusing now on the potential co-benefits of emission offsets, that is, their positive externalities to the local communities, the overall performance of CDM offsets seems to be poor, though with significant spatial and technological heterogeneity (Hultman et al., 2020). For instance, a variety of offset projects, ranging from energy-related to forest ones, enhanced the quality of water basins in the proximity of the implementation area (Karlsson et al., 2020; Anderson et al., 2017, Torres et al., 2015). By contrast, employment co-benefits in developing countries were found to be short-lived at best. On average, they dwindled after about three years from project implementation (Mori-Clement and Bednare-Friedl, 2019; Crowe, 2013). On the bright side, the weak link with employment in developing countries also means that the collapse of the CDM credit price did not have major negative repercussions on employment. Employment effects also show strong sectoral heterogeneity. Employment in some sectors was positively affected (e.g. construction), whereas others suffered economic damages (e.g. agriculture) (Mori-Clement and Bednar-Friedl, 2019).

In general, scholars highlight that when there are trade-offs between climate change mitigation and other societal objectives, project developers tend to focus on emissions abatement, since crediting proceeds depends on the latter (see Freeman and Zerriffi, 2012 for a review of health co-benefits of cookstove projects, and Hultman et al., 2020 for a broader review of co-benefits). The economic incentive linked to emission abatement is, therefore, insufficient for bringing about broader co-benefits and a market premium needs to be applied to reward projects with a positive societal impact (Dulaney et al., 2017; Crowe, 2013).

3.2 Linking-specific literature

A dedicated literature on the implications for ETS linking of heterogeneity in offset provisions does not really exist. However, some scholarly works dealing with the possible barriers to ETS linking do touch upon offsets provisions. From a technical perspective, perfect harmonisation of offsets provisions is not deemed to be necessary, as the linking arrangement between California and Quebec demonstrates. While the two jurisdictions apply the same quantitative limit to offsets use (8% of emissions covered by allowances), they differ in the qualitative limits (Purdon et al., 2014). However, there are reasons for which harmonisation over offset provisions might be regarded as being highly relevant in economic and political terms. Different qualitative restrictions, in particular, may reflect different preferences or priorities of policymakers. If so, harmonisation could become a politically sensitive matter and thus hinder linking negotiations (Burtraw et al., 2013; Hawkins and Jegou, 2014; Tuerk et al., 2009). Differences in quantitative restrictions appear to be more relevant to the economic dimension. It has been noted that if one ETS accepts credits as compliance units, while the other does not (or only to a lesser extent), entities under the first scheme will likely use cheaper credits for compliance up to their maximum. By doing so, they would 'free up' allowances that could be sold to the other jurisdiction (Santikarn et al., 2018; Kachi et al., 2015; Lazarus et al., 2015; Burtraw et al, 2013; Zetterberg, 2012). While quantitative limits on offsets use may shelter an ETS from external price fluctuations (Diaz-Rainey and Tulloch, 2018), if the same limits do not apply in all linked ETSs, then the 'freeing up' effect would still hold in some measure (Lazarus et al., 2015; Beuermann et al., 2017; Santikarn et al., 2018). Overall, the literature seems to indicate that differences in quantitative limits to the use of offsets between ETSs reflect a more general divergence in terms of climate ambition. As to qualitative limits, a sufficiently high level of trust seems to be required for regulators to overcome their reluctance to accept reciprocal standards. Arguably, if both sufficient convergence on ambition (stringency) and mutual trust are necessary pre-conditions for any linking negotiation to start (Verde et al., 2020; Mehling and Haites, 2009), the alignment of offsets provisions is a necessary condition for a linkage negotiation to succeed.

4. Data from the ETSs in the Carbon Market Policy Dialogue

4.1 California-Quebec

4.1.1 State of Play

Compliance Offset Programs have been critical cost containment provisions since the inception of the California and Québec Cap and Trade programs. Offsets are tradable credits representing real, verifiable, additional voluntary GHG emission reductions in projects or facilities not covered by the cap and trade program. Compliance entities with emissions obligations use offset credits to reduce program costs, provide flexibility, and motivate GHG reductions in uncapped sectors.

In establishing Compliance Offset Programs, California and Québec follow the 2010 Western Climate Initiative (WCI) Offset System Essential Elements Final Recommendations and the 2012 WCI Final Recommendations for the Offset System Process which include guidelines for the inclusion of offsets that can be used for compliance across linked jurisdictions. The WCI recommendations ensure that offsets reduce compliance costs and maintain the environmental integrity of the cap, or emissions limit, by specifying rigorous criteria to ensure that offsets result in real, additional, verifiable, and permanent GHG reductions. The WCI recommendations specify that a maximum of 49% of emissions reductions can be achieved through offsets (allowing for jurisdictions to implement lower offset usage limits) and define requirements of WCI offset projects, including issues related to offset ownership, geographic boundaries, quantification and uncertainty, leakage, and ensuring real GHG emission reductions.

Under the WCI guidelines, an offset credit is defined as a compliance instrument issued by a partner jurisdiction representing a reduction or removal of one metric ton of carbon dioxide equivalent (CO2e) that meets criteria to be “real, additional, permanent, and verifiable.” Jurisdictions can issue offset credit from projects located inside their boundaries and in any non-WCI jurisdiction within North America. The WCI recommendations also stipulate that jurisdictions may develop criteria to accept offset credits from outside North America that meet the rigorous WCI standards.

Following the WCI recommendations, California and Québec developed rigorous Compliance Offset Protocols to ensure consistent, transparent, and accurate quantification of GHG emission reductions from offset projects. Protocols include quantification methodologies and regulatory program requirements for offset providers to develop specific offsets projects that can be used to generate offset credits for each jurisdiction. Compliance Offset Protocols are considered regulatory documents and are developed through robust public processes in each jurisdiction. California and Québec have coordinated to ensure that offset protocols follow the 2012 WCI Final Recommendations for the Offset System Process. This includes the process for pre-verification (monitoring and quantification, validation and registration, and reporting), verification and issuance (verification, certification, and issuance), and post-verification monitoring to ensure that offset credits are fungible across linked jurisdictions.

Compliance offset protocols

The California Air Resources Board (CARB) implements California’s Cap and Trade Program. It develops and approves compliance offset protocols with provisions for quantification, documentation, verification, monitoring, and enforcement of GHG reductions achieved through offset projects. California works closely with linked jurisdictions to ensure that offset protocols are consistent with WCI requirements and that offsets provide cost-effective GHG reductions and co-benefits for the jurisdiction, including an emphasis on in-state projects. Legislation in California, Assembly Bill 32 the Global Warming Solutions Act of 2006, puts additional requirements on offsets used for compliance in the California Cap and Trade Program. California must ensure that all GHG reductions are real, permanent, quantifiable, verifiable, enforceable, and additional.

Since the inception of the Cap and Trade Program, California has developed six compliance offset protocols following WCI offset project requirements. These six offset protocols are:

- Compliance Offset Protocol Livestock Projects: GHG emission reductions associated with the installation of biogas control systems for manure management on dairy cattle and swine farms.
- Compliance Offset Protocol Mine Methane Capture Projects: GHG emission reductions associated with the capture and destruction of methane that would otherwise be emitted from active surface and underground mines and abandoned underground mines.
- Compliance Offset Protocol Ozone Depleting Substances (ODS) Projects: GHG emission reductions associated with the destruction of high global warming potential (GWP) ozone depleting substances that would otherwise be released from foam blowing agents and refrigerants in the U.S.
- Compliance Offset Protocol Rice Cultivation Projects: GHG emission reductions associated with methane emissions from flooded rice fields.
- Compliance Offset Protocol for U.S. Forest Projects: GHG emission reductions associated with activities that sequester carbon on forestland.
- Compliance Offset Protocol for Urban Forest Projects: GHG emission reductions associated with tree planting and maintenance activities to sequester carbon in trees in urban areas.

The Ministère de l'Environnment et de la Lutte contre les changements climatiques implements Québec's Cap and Trade System and develops Compliance Offset Protocols following WCI requirements to ensure fungibility of offset credits across linked jurisdictions. Québec has developed five Compliance Offset Protocols:

- Compliance Offset Protocol Covered Manure Storage Facility Projects: GHG emission reductions associated with installation of biogas control systems for manure management on dairy cattle and swine farms
- Compliance Offset Protocol Landfill Site Projects: GHG emission reductions associated with the capture and destruction of methane from landfill sites
- Compliance Offset Protocol Destruction of Ozone Depleting Substances (ODS) Projects: GHG emission reductions associated with the destruction of high global warming potential (GWP) ozone depleting substances that would otherwise be released from refrigeration, freezer, and air-conditioning appliances
- Compliance Offset Protocol Active Coal Mine Projects: GHG emission reductions associated with the capture and destruction of methane that would otherwise be emitted from drainage systems in active coal mines
- Compliance Offset Protocol Active Underground Coal Mine Projects: GHG emission reductions associated with the capture and destruction of methane that would otherwise be emitted from ventilation air in active underground coal mines

Offset Project Operators develop offset projects within these California and Québec certified protocols and generate offset credits that can be used for compliance across linked jurisdictions. Third-party Offset Project Registries help administer the Compliance Offset Programs. Registries facilitate the listing, reporting, and verification of offset projects developed under Compliance Offset Protocols. They must meet specific regulatory criteria from each jurisdiction as well as follow WCI offset guidelines.

As of June 2021, 221 million compliance offset credits have been issued under four California Compliance Offset Protocols (ODS, livestock, U.S. forests, and mine methane capture projects). In addition, 1.1 million compliance offset Québec has issued credits under two Offset Protocols (ODS and landfill projects). These credits can be used for compliance by regulated parties in California and Québec. Through April 2021, 94 million offset credits had been used for compliance by regulated parties in California and Québec.

Moving forward, both California and Québec are considering additional Compliance Offset Protocols. These new Protocols focus on achieving GHG emission reductions within the boundaries of each jurisdiction and maximize environmental, social, and economic co-benefits in line with legislative and regulatory requirements as well as WCI recommendations.

Compliance offsets in the California Cap and Trade Program

California's Cap and Trade Regulation outlines the quantitative offset usage limit for each regulated entity following WCI recommendations. Legislation in California has also required regulatory changes to California's offset usage limit and placed requirements on offset usage that maximize direct environmental benefits of offset projects to California. During the first three compliance periods, 2013-2020, California regulated entities could satisfy up to 8% of their compliance obligation using Compliance Offset Credits. Assembly Bill 398 (AB 398) passed in 2017 and changed the Offset Usage Limit for the 2021-2030 period. From 2021-2025, the Offset Usage Limit is 4% for California covered entities and increases to 6% from 2026 to 2030.

AB 398 also places limits on the types of offsets used by California covered entities, which is reflected in the current California Cap and Trade Regulation. Beginning in 2021, no more than half of a covered entity's Offset Usage Limit can come from offset projects that do not provide direct environmental benefit (DEBS) to California. Offset projects located inside California provide DEBS, while offset projects outside California may provide DEBS based on specific criteria as evaluated by CARB.

California's Cap and Trade Regulation also contains monitoring, verification, and enforcement of GHG reductions associated with California offset credits. The California Cap and Trade Regulation includes a provision to invalidate Compliance Offset Credits that have been issued but found to violate the requirements of WCI and the Cap and Trade Regulation. If CARB determines that a Compliance Offset Credit is invalid after it is issued, CARB will cancel it. The user of the credit is required to replace it with another valid compliance instrument. The buyer of the Compliance Offset Credit is therefore liable for the validity of the offset credit, known as buyer liability, as the buyer (and not the issuing jurisdiction of California) is responsible for the integrity of the GHG emission reduction.

In addition, AB 398 requires the creation of the Compliance Offset Protocol Task Force to guide CARB in creating additional Compliance Offset Protocols that provide DEBS to California, prioritizing disadvantaged communities, Native American or tribal lands, and rural and agricultural regions.

Compliance Offsets in the Québec Cap and Trade System

Quantitative offset usage limits are outlined in Québec's Regulation Respecting a Cap-and-Trade System for Greenhouse Gas Emission Allowances. Up to 8% of a regulated entity's compliance obligation can be satisfied using Compliance Offset Credits issued by Québec or linked jurisdictions. The Ministère can only issue Compliance Offset Credits for the five approved protocols. However, an additional Compliance Offset Protocol related to afforestation and reforestation projects on private lands in Québec is currently under development and anticipated to be finalized in 2021.

The Québec Regulation also includes specifications on the handling, processing, and enforcement of Compliance Offset Credits. Offset credits issued in Québec are guaranteed by the Offset Project Operator, who develops the offset projects and generates the GHG emission reduction. Thus, if Compliance Offset Credits are issued and later found invalid, the credit generator (and not the buyer) is responsible for providing credible compliance instruments to cover the GHG emission reductions from the invalidated offset. If the Offset Project Operator cannot replace the offset credits, the Ministère will retire an equivalent number of compliance instruments from the Minister's Environmental Integrity Account, funded by withholding 3% of issued Québec Compliance Offset Credits.

Sector-based offset credits

As outlined in the 2010 WCI Offset System Recommendations, WCI partner jurisdictions may accept offset certificates outside North America. In addition, recognizing the significant role of GHG emissions from tropical deforestation and degradation in contributing to global climate change, the California Cap and Trade Regulation includes the potential for international offset credits generated through approved sector-based crediting programs in developing countries. CARB has not approved any sector-based crediting programs but is evaluating the potential to include sector-based crediting programs related to tropical forestry.

4.1.2 Relevant experience

California and Québec have a well-established Compliance Offset Program built on the foundation of WCI recommendations and historical experience of offset usage in other ETS programs. California's and Québec's Compliance Offset Protocols with stringent requirements for real, verifiable, additional, and permanent emission reductions are often viewed as a gold standard in global offset programs. Each jurisdiction ensures that GHG emission reductions attributed to Compliance Offset Credits are guaranteed – either by the generator, the buyers, or the regulating jurisdiction – ensuring the environmental integrity of the emissions caps.

Compliance Offset Credits have been part of the California and Québec Cap and Trade Programs since inception. Historically, regulated entities have not utilized the full compliance offset limit. Across all entities, about 4% of California's Compliance Offset Limit has been historically used for compliance. California and Québec Compliance Offset Credits are fully fungible across jurisdictions and traded on the secondary market through the InterContinental Exchange as California Carbon Offset Futures (CCO). As of June 2021, Compliance Offset Credits are trading at about 70% of the value of current vintage Compliance Allowances on the secondary market.

Compliance Offset Credits are a fundamental cost containment provision of ETS systems. They provide compliance flexibility, motivate GHG emission reductions in uncapped sectors, and can reduce the overall cost of compliance. California and Québec are working to increase the supply of Compliance Offset Credits that can reduce costs and ensure the environmental integrity of the Cap and Trade Programs while also maximizing direct environmental benefits to the jurisdictions. As the auction price floor continues to rise at 5% each year and the stringency of the emissions caps increases on the way to stringent 2030 emissions targets, there is certain demand for low-cost compliance options, including Compliance Offset Credits into the future.

4.2 China

4.2.1 State of play

In 2017, the "National Carbon Emission Trading Market Construction Plan (Power Generation Industry)" proposed to "include national certified voluntary emission reductions in the national carbon market as soon as possible." On April 3, 2019, the Ministry of Ecology and the Environment of the People's Republic of China drafted the *Interim Regulations on the administration of Carbon Emission Trading (Draft for comments)*. According to the draft, the carbon emission reduction units that meet the requirements of the competent department of Ecology and the Environment under the State Council can be used for offset, but the rules for this are not clearly stated. On March 30, 2020, the Ministry of Ecology and Environment publicly solicited opinions on the *Interim Regulations on the Administration of Carbon Emission Trading (Revised Draft)*. The State encourages enterprises and institutions to implement projects on renewable energy, forestry carbon sink and methane use in Chinese territory in order to carry out technological replacement, emissions absorption and to reduce greenhouse gas emissions.

As with the operation experiences of the current pilot carbon market, the types and restrictions of using certified emissions reductions vary across pilots. Chinese Certified Emission Reduction (CCER) is not the only option for some pilots, and the Fujian carbon market can use the Fujian forestry carbon

sink (FFCER), while the Guangdong carbon market allows the use of Puhui Certified Emission Reduction (PHCER[2]). Different carbon markets also have different limits and restrictions for CCER.

On February 1, 2021, the Ministry of Ecology and the Environment published *Measures for the Administration of Carbon Emission Trading (For Trial Implementation)*. According to this, the ceiling offset use limit of CCER shall not exceed 5% of the allowances in the next years.

The development of China's CCER mechanism

In 2012, the National Development and Reform Commission (NDRC) officially issued *Interim Measures for the Administration of Voluntary Greenhouse Gas Emission Reduction Trading*[3] and the *Guidelines for the Accreditation and Certification of Voluntary Greenhouse Gas Emission Reduction Projects*. They also recorded the related methodology, and established a voluntary greenhouse gas emission reduction trading mechanism. The emission reductions produced by voluntary emission reduction projects can be registered as national CCER through relevant methods and procedures. CCER's project review and certification are strictly managed and filed by the Department of Climate Change response to the State Council. Furthermore, in 2015, the national voluntary emission reduction trading registration system was put into operation. With this system, the project owner could open an account to record any CCER credits that were issued.

By March 2018, the NDRC had recognized nine trading institutions that can act as a trading platform for CCER credits, and twelve certification institutions for project validation and verification. At present, the state has issued 200 greenhouse gas project verification and emission reduction certification methodologies. Of these, 173 were adapted from CDM methodologies, while 27 were newly developed methodologies. All relevant information on voluntary emission reduction credit trading, including project process (publication, registration and issuance situation), approved methodologies and other relevant administrative and technical regulations such as the validation/verification standard of CCER projects and provisions concerning additionality, persistency, measurability, and real (past) abatement, can be obtained from the Chinese voluntary emissions trading information platform[4]. This is the official platform for CCER information disclosure. CCER projects in China have developed rapidly. By February 28, 2018, the NDRC had published a total of 2,856 projects which have achieved validation: 1,047 projects have been registered and 287 projects have been issued emission reduction credits.

The offset mechanism in the ETS pilots

All ETS pilots in China accept CCER credits as compliance units, and have designed restrictions. The restrictions mainly focus on project type, location and issuance time.

Regulatory framework

The general provisions on the offset mechanism in the pilot areas are embodied in "management measures". In addition, Beijing, Shenzhen, Guangdong and Fujian have promulgated separate offset mechanism management measures or regulations which specify restrictions. Shanghai, Hubei and Tianjin have issued relevant notices on the use of the offset mechanism. Such notices were issued annually by Shanghai and Hubei pilots, so some details of the restrictions differ between compliance periods.

Qualitative restrictions on the offset credit type

All pilots can use a certain number of CCER credits for compliance obligations, while Beijing, Guangdong, and Fujian have their own design with a combination of local features. Beijing recognizes two additional types of local emission reduction credits, from energy saving projects and carbon sink projects. The eligible energy saving projects allow organizations not covered by the Beijing pilot to reduce

2 PHCER is approved by the Chinese local government tier (usually at the provincial level).

3 http://cdm.ccchina.gov.cn/WebSite/CDM/UpFile/File2894.pdf

4 http://cdm.ccchina.gov.cn/ccer.aspx

emissions and to generate credits through energy savings from technological transformation activities, energy performance contracting or clean production projects. The forestry carbon sink projects are essentially based on the mechanism of the CCER carbon sink projects. Sixty percent of emission reductions achieved by local carbon sink projects, which are not registered, could be used as credits in Beijing's pilot. The CCER project registration and credit issuance process could be conducted after registration.

Fujian introduced its own forestry carbon sink projects to be accepted for the pilot trading system. According to *Interim Measures for the Administration of Carbon Emission Offset in Fujian Province*, the forestry carbon sink projects must be implemented in accordance with the methodology issued by the NDRC or the provincial Development and Reform Commission. By November 2019, 12 forestry carbon sink projects had been registered under the Fujian pilot, and 1.84 million tonnes of credits had been issued.

Guangdong introduced the provincial Pu Hui Certified Emission Reduction (PHCER) project mechanism. As a supplementary mechanism for the emissions trading market, the emission reductions achieved under the PHCER mechanism is equivalent to CCER credits generated in the Guangdong province, and can be used to offset the actual carbon emissions of covered entities in the trading system. At present, there are five approved provincial-level methodologies, covering forest protection and management, distributed photovoltaic power generation, energy conservation, as well as urban mobility. By January 2020, a series of forest protection and management projects and distributed photovoltaic power generation projects have been registered with 1.07 million tonnes of PHCER credits.

Quantitative restrictions on credits

The current CCER offset ratio in the local carbon markets at home is around 1% to 10%. In Shenzhen, an upper limit to offsets use is set at 10% of compliance: Shanghai does not exceed 1% of allowances; Beijing no more than 5% of allowances; Guangdong no more than 10% of compliance; Tianjin no more than 10% of compliance; Hubei no more than 10% of initial allowances; Chongqing no more than 8% of compliance; and Fujian shall not exceed 10% of compliance.

Qualitative restrictions on project types

All pilot ETSs have restrictions on the project type from which credits can be used for compliance. Beijing, Guangdong, Chongqing and Tianjin do not accept credits from hydropower projects, while Hubei accepts small-scale but not large- and medium-sized hydropower projects. Beijing has excluded industrial gas (HFCs, PFCs, N_2O, and SF_6) projects from crediting. Guangdong requires that only credits from projects with CO_2 and CH_4, accounting for more than 50% of total emission reductions, can be used. In addition, Guangdong has restricted emission reduction projects in power generation and heating by fossil fuels except for coalbed methane and waste energy recovery projects. From 2016 to 2018, the annual notice on offset mechanism issued by Hubei Province stipulated that only emissions reduction credits generated by rural methane and forestry projects could be used for compliance in those years.

Qualitative restrictions on project location

Pilot carbon markets in Beijing, Guangdong, Hubei, and Fujian have some localized requirements for carbon offset credits. 50% of the CCER used for offsetting in the Beijing pilot carbon market must be generated locally in Beijing. The carbon offset credits of Chengde City in Hebei Province, which has developed cross-regional cooperation with Beijing, are recognized as carbon offset credits generated locally in Beijing. The Guangdong pilot carbon market requires that more than 70% of the CCERs used for offsets are from Guangdong. The Hubei and Fujian pilot carbon markets require that all CCERs used for offsets must come from local areas. In July 2016, the Hubei carbon market required that the CCER used for offset must be generated in contiguous destitute areas in Hubei Province; in June 2017, the CCER utilized for offsets was required to come from the key counties included in the national plan for poverty alleviation through development of the city cluster on the middle reaches of the Yangtze River.

Qualitative restrictions on issuance time

The carbon markets in Beijing, Shanghai, Tianjin, Guangdong, Hubei, Chongqing, and Fujian all have clear restrictions on the time of CCER issuance. The pilot carbon markets in Beijing, Shanghai and Tianjin require that the CCER issuance time must come after January 1, 2013. The Hubei pilot carbon market sets different time requirements depending on the supply and demand of allowances each year. In 2016, the crediting period for projects' emission reductions was from January 1, 2015 to December 31, 2015. In 2017, the crediting period was required from January 1, 2013 to December 31, 2015. The Guangdong pilot carbon market does not have a clear time limit. But credits from pre-CDM projects (i.e. projects that generated emission reductions prior to CDM project registration) cannot be used for compliance, and most of the early projects were actually cancelled, which is equivalent to a time limit. The Chongqing pilot carbon market required that CCER projects must have been put into operation after 2011. The Fujian pilot carbon market stipulated, instead, that the CCER project has to start after February 16, 2005.

4.2.2 Relevant experience

According to the trading data published by various regional trading institutions, as of March, 2020, the total trading volume of CCERs was as listed in the table below. It is worth noting that under current CCER offset rules in pilot markets, wind power, small hydropower, solar power and forestry carbon sink projects are relatively popular.

Table 1 CCER trading amount in the pilots

Pilot	Cumulative trading amount (CCERs, tCO_2eq)
Shanghai	94,354,660
Beijing	24,206,687
Guangdong	45,465,895
Shenzhen	18,406,664
Hubei	7,659,169
Tianjin	3,508,926
Fujian	7,888,745
Chongqing	-
Total	201,490,746

After several years of pilot operation, the operating mechanism for each pilot carbon market has been continuously improved to increase integrity, but the problem of too many available offsets still exists. It is found that the available supply of credits is much larger than demand in most pilots. This has led to trading downturns in some pilots (Li et al, 2018). Table 2 shows available offsets and actual offset market amount for seven pilot carbon markets in China in 2017. The total credits volume traded in 2017 represented nearly 50 million tonnes, about three times that of 2014. But the available amount of offsets over the same period exceeded 100 million tonnes. Among them, only two pilots, Shenzhen and Beijing, recorded a demand for credits larger than its supply. The Tianjin pilot carbon market traded only about one million tonnes, less than 10 percent of the public auction volume (not including trading under large agreements). In general, there is still the problem that the number of available credits in the current pilots is too large.

Table 2 Available amount and actual trading volume of offsets for seven pilot carbon markets (2017)

	Shanghai	Beijing	Guangdong	Shenzhen	Hubei	Tianjin	Chongqing
Use limit	5%	5%	10%	10%	10%	10%	8%
Available amount of offsets (Mt)	7.8	2.3	42.2	3.0	25.7	16.0	8.0
Actual market trading amount of offsets (Mt)	2.46	2.38	12.37	6.91	14.87	1.16	6.78

From the perspective of the relationship between CCER transaction price and the price fluctuation of the allowance, Guangdong was taken as an example to be analyzed by the neural network model (Rao, 2019). By fitting the allowance trading price fluctuation in Guangdong Province, significant influencing factors are the price of crude oil, the auction price of allowance, the trading price of clean energy and the trading price of CCER. Among these four factors, the energy price has the largest influence, while the trading price of CCER has the least influence. By analyzing the impact of offsetting mechanisms on allowance prices in six pilots in China (Lu, 2019), it has been found that due to the current low price of CCER, the introduction of CCER will reduce the allowance price. At the same time, the influence of the CCER offset mechanism on allowance prices is continuous and stable, and there is no significant difference when near the compliance deadline.

In terms of the correlation between offset mechanism and market liquidity, the price of CCER is lower than that of allowance most of the time. Taking Guangdong as an example, the average price of allowance is 27 RMB/t in 2020, while the average price of allowance is 20 RMB/t (Tanjitaoyi.com, 2021). When CCER is supplied to increase overall supply, the market will reduce the demand for allowances, thus reducing the liquidity of the carbon market (Dai et al, 2019; Fu et al, 2017).

Concerning the relationship between carbon trading and forestry carbon sinks, Shanghai was taken as an example to be analyzed based on a computable general equilibrium model (Zao et al, 2018). The results show that in the early development of carbon trading, the offset use limit should be appropriately controlled. On the one hand, the stringency of CCER needs to be improved upon to prevent low-quality projects entering the market. On the other, we will enhance the price stability of offsets by controlling the total amount for compliance while making full use of forestry carbon sinks. There are also several studies that have analyzed the proposed CCER use limit on the national carbon market. It is found that CCER scheme can save costs for China's carbon trading system. Depending on the actual situation in China, the ceiling offset use limit of CCER does not exceed, it is suggested, 6% (Li et al, 2019).

In general, the introduction of offsets could increase the overall supply, reduce the allowance price, and increase the liquidity of the carbon market. In the initial stage of the construction and operation of the national carbon market, especially at the stage when carbon price control measures are insufficient, offsets may be considered to help keeping prices in check. Regarding the types of offset credits, it is recommended to follow the principle of "starting with the easier ones before difficult ones and adjusting step by step". This is in order to reduce the complexity of the system design. Initially, CCER should be used, and then other carbon emission reduction certificates would be considered. At different stages of the development of the carbon market, the Department for Addressing Climate Change under the State Council can choose different carbon emission reduction certificates based on different market conditions.

4.3 European Union (EU)

4.3.1 State of play

Quantitative and qualitative restrictions

In the EU ETS, offsets of any kind have no longer been accepted since the start of Phase IV (2021-2030).

4.3.2 Relevant experience

Brief history of the impact of offsets on the EU ETS

During its pilot Phase I (2005-2007), the EU ETS admitted the use of CDM and JI credits as compliance units, without a corresponding adjustment in allowance supply. This means that, in effect, each credit used for compliance increased the supply of the carbon market, as one allowance was 'freed up'. However, no credit was actually used for compliance, as firms received most of their allowances for free and allowance supply significantly exceeded emissions. So much so that, in April 2006, the allowance price nearly reached zero when it first became clear that the market was oversupplied (Trotignon, 2012). Back then, banking between trading periods was not allowed, so there was no point in buying or keeping compliance units for future periods. Even if no transaction of credits occurred during this period, the European Commission had already put forward some qualitative limitations to the use of credits. This was the case of nuclear power generation projects and Land Use, Land Use Change, and Forestry (LULUCF) projects (European Parliament and the Council of the EU, 2004).

Use of offsets for compliance under the EU ETS started during Phase II (2008-2012). But soon multiple problems arose related to frauds on the double counting of offsets, additionality concerns, and questions about the environmental value of the projects (Trotignon and Delbosc, 2008). For this reason, Phase II also saw the first quantitative limits to offsets use being implemented. Member States applied quantitative limits to offsets use in the form of maximum shares of offsets over compliance units. Such limits had to be compatible with the national Kyoto Protocol commitment and showed significant cross-country variation, ranging from 0% in Estonia to 20.6% in Spain. Operators could use offsets up to the allocated limit in Phase II or they could bank them for future use in Phase III (2013-2020). In addition, strict requirements were applied to credits from hydroelectric power generation (Trotignon, 2012). During this period, the Great Recession hit the European carbon market, leading to a dramatic fall in allowance demand and, thus, to a huge excess supply and low carbon prices. On average, installations did not use offsets up to the nationally determined limits. Besides the economic downturn, another reason why operators did not rely more heavily on credits, despite being cheaper than allowances, is that the supply of credits was still lower than the potential demand of European installations, represented by the national quantitative limit. Overall, during Phase II, 11% of emissions under the EU ETS were covered by offsets (Ellerman et al., 2014, 2015).

More stringent limits on the use of offsets were set for Phase III (2013-2020). First, a targeted restriction applied to industrial GHG destruction projects, as it appeared to be economically convenient to produce these emissions to be later destroyed for credits issuance and sale (Cames et al., 2016; Schneider and Kollmuss, 2015). Therefore, credits from industrial gas destruction (HFC-23 and N2O) were no longer accepted. Second, credits issued within the first commitment period of the Kyoto protocol (2008-2012) could be used only up to 2015. Third, credits generated during the second commitment period of the Kyoto Protocol (2013-2020) were only admitted if the related projects were located in least developed countries. Finally, during Phase III, centralised quantitative limits applied: offsets could represent maximum 50% of the overall cap reduction to take place within the trading period. The number of offsets used decreased significantly between Phase II and Phase III, falling from roughly one and a half billion CERs, in the former period, to almost half a billion in the latter.

Along with the harsh crisis that hit the European economy in 2008-2009, and the consequent accumulated excess supply of allowances, the availability of cheap offsets contributed to allowance prices taking persistently low values until 2018.

Other relevant experience with offsets

Over the years, the European Commission contracted several studies assessing the performance of emission credits (e.g., Alessi and Fujiwara, 2011; Chatterjee, 2011; du Monceau and Brohé, 2011; du Monceau et al., 2011; Nyaoro and Chatterjee, 2011; Ruthner et al., 2011). Many of them were released in 2011 and informed the subsequent reform of the rules on offsets use. The main points highlighted in the reports include: the additionality concerns discussed above; evidence of carbon leakage; benefits from technological transfers to developing countries; and compatibility with a commitment to sustainable development. Building on the analysed evidence, the reports outlined potential reforms of the CDM crediting system that informed Phase III reforms on offsets provisions. The European Commission commissioned another study, released in 2016, which focused on additionality concerns, already acknowledged to be the most controversial issue from previous reports. Cames et al. (2016), the study in question, found that only 2% of the CDM projects (representing 7% of potential CER supply) had a high likelihood of ensuring emissions abatement that was genuinely additional and not subject to overestimation. The main recommendations of the authors for the EU ETS were to restrict offsets use to credits from emission abatement projects with a high likelihood of additionality and, more generally, to set mitigation objectives so that they would not be overly reliant on the use of credits.

Interactions with linking

The linkage between the EU ETS and Switzerland's ETS became operational on 1 January, 2020. As part of the linking negotiation, the EU and Switzerland agreed not to admit the use of offsets in the linked market from 1 January 2020. The two ETSs are not currently linked, either directly or indirectly, to any other carbon market.

Public debate and future directions

The European ambition of carbon neutrality by 2050 implicitly suggests the possibility that carbon removals or offsets may be (re-)introduced in the policy framework. Recently, the relevant public debate has centred on Negative Emission Technologies (NETs), which remove GHGs from the atmosphere and either store it or use it as inputs to other economic activities. While there are still no economic incentives for deployment of NETs at scale, different policy options are envisaged. Inclusion of NETs in the EU ETS is one of the discussed scenarios, whereby removals could be incentivised by the issuance of credits admitted for compliance (see e.g., ICAP 2021; Verde and Chiaramonti, 2021).

4.4 New Zealand

4.4.1 State of play

Quantitative and qualitative restrictions

The NZ ETS does not currently accept offsets from international sources. The Emissions Trading Reform Act 2020 put in place provisions for the future acceptance of 'approved overseas units'. The legislation requires that any future use of international units in the ETS must have quantitative limits which are to be set as part of the process of setting and enforcing caps. In addition, it puts a responsibility on the Government to ensure that 'offshore mitigation' should be real, additional, and robustly accounted for.

About 38% of New Zealand's land area is covered by forest, comprising 8 million ha of indigenous forest and over 2 million ha of plantation forest. The management of indigenous forest is regulated to ensure sustainability, and it is almost entirely unaffected by the NZ ETS. Plantation forestry, however, is largely a commercial enterprise. CO_2 emissions and removals from plantation forestry are a very important part of New Zealand's emission profile. Forestry removals have an important role and may be used to offset emissions, but there is also potential for significant emissions related to harvesting and deforestation.

Plantation forest owners who establish and maintain 'post-1989' forest – on land that had not previously been used for long-term forest – may register voluntarily and receive emission units equal to their removals over time. Once registered, a forest owner must monitor and report on the carbon stocks in the forest. They must surrender New Zealand emission units (NZUs) for any losses due to deforestation or timber harvesting. There is also an option to deregister and leave the NZ ETS, but all units allocated must be repaid.

This 'stock change accounting' approach is currently used for post-1989 forestry in the ETS. However, the Government now has plans to move to an 'averaging' approach for forests that are registered from 1 January 2023. This will mean that owners of a newly planted forest can only be allocated units up to its expected average carbon stocks, and in general they will only surrender units if they deforest. The NZ ETS will provide a clearer incentive to plant new forest, and a corresponding disincentive to deforest the land.

New Zealand also has a forestry offset scheme known as the Permanent Forest Sink Initiative (PFSI) which is used for establishment of new indigenous forest. It has similar rules to post-1989 forestry in the NZ ETS, with the addition of long-term commitments to manage the forest sustainably.

4.4.2 Relevant experience

Brief history of the impact of offsets on the NZ ETS

Using the Kyoto mechanisms

When the New Zealand Parliament passed the 2008 legislation that established an ETS, linking to the international Kyoto system was considered an integral part of the policy. The Kyoto flexibility mechanisms were considered important to provide liquidity and scale that would not have been possible with a purely domestic market. The legislation allowed for NZ ETS participants to import and surrender Kyoto units derived from project activities. Participants could import and surrender CERs, ERUs, and RMUs.

The legislation did not make any provision for the Government to impose limits on the number of international offsets that could be imported or surrendered from time to time. At the time that this legislation was passed, prices for these Kyoto units were higher than for New Zealand units. There was no immediate prospect that New Zealand participants would buy large numbers of international offsets – they only functioned as a reserve supply. Some surplus New Zealand forestry units were exported for voluntary or compliance use as offsets in other jurisdictions.

The Government made several changes to the NZ ETS in 2012, and the possibility of setting limits on international offsets was discussed at that time. However, in the context of recovery from the global financial crisis, the Government saw low emission prices as necessary in the short term. No decision was made to change this aspect of the legislation, and it signalled its intention to continue accepting international offsets for surrenders covering the calendar 2013 and 2014 compliance years. Although the prices of Kyoto units fell to very low levels with the end of the first commitment period, the Government followed through on this perceived commitment to keep accepting them. They were accepted for surrender until 31 May 2015, which was the deadline for the 2014 compliance year [5].

There were concerns about additionality and other issues for some Kyoto projects as early as 2008. The Government excluded units from some classes of projects, such as large hydroelectric dams, from surrender in the NZ ETS because of concerns about their environmental and social impacts in host countries. Some classes of CDM and JI project units were banned by regulation in 2011 and 2012 because of concerns about their additionality. However, Kyoto units from all other project types were still eligible for surrender, with no quantity limit. Participants took advantage of this rule from late 2012 when large numbers of ERUs became available at low prices. Many of these also came from projects with issues of doubtful additionality and probable over-reporting of emission reductions (Kollmuss et al., 2015).

5 New Zealand could have also allowed the import of second commitment period CERs – the only second commitment period units available – after 2012, but did not do so.

In late 2013 and early 2014, some forestry participants deregistered part or all of their forest land from the NZ ETS, using newly imported Kyoto units to cover all the repayments that were required. At the time NZUs traded at higher prices than Kyoto units, because NZUs were not vintaged and would still be tradable and valid after 2015. Forest owners could benefit from the difference in value between the NZUs that they had been allocated, and the cheap Kyoto units (mainly ERUs derived from Russia and Ukraine) that they surrendered. It is likely that they had an intention of trying to achieve further arbitrage by re-registering the same forests.

The Government passed urgent legislation in early 2014 to stop this arbitrage activity, by requiring only NZUs to be used for deregistration of forest land. Forest owners and other participants could still use international offsets for surrenders covering actual emissions, up to the date that had already been announced. The unlimited use of international offsets depressed prices and reduced the effectiveness of the NZ ETS up to 2015. It also allowed participants to build up a stockpile of NZUs, since very few of the NZUs allocated at that time were surrendered. This resulted in an over-supply of NZUs which still exists and is being addressed by withholding units from the ETS caps.

Forestry in New Zealand

The PFSI was established in 2006, so predates the NZ ETS. This activity will be transferred into the NZ ETS in the next two years as 'permanent post-1989 forestry'. In addition to the same obligations as post-989 forest owners, PFSI or permanent forest owners have a commitment to maintain the forest sustainably. There is an option to leave the scheme after 50 years and again every 25 years, but only on the condition of repaying all units. PFSI forest owners have often sold units for cancellation as part of a voluntary offsetting market.

There was significant deforestation in New Zealand in the five years before the NZ ETS was established, as existing plantation forest was removed to convert land for dairy farming. The Government saw forestry emissions and removals as an urgent issue that needed to be addressed immediately to ensure that New Zealand could meet its Kyoto Protocol commitments, as well as for the longer term. The NZ ETS put mandatory surrender obligations on any deforestation of pre-existing plantation forests (established before 1990) from 1 January 2008.

Voluntary participation of post-1989 forest was also made available from the start of the NZ ETS in 2008. It has had success in incentivising forestry, in spite of low unit prices from 2012 to 2016 (Carver et al., 2017). However, the stock change accounting approach has meant that substantial numbers of units have been allocated and are expected to be banked and surrendered to cover harvesting obligations. Long-term banking obscures the true level of supply in the NZ ETS and may reduce liquidity for other participants.

Other relevant experience with offsets

New Zealand's independent Climate Change Commission delivered its final advice on the first three national emission budgets, and on the basis for an emission reduction plan, to the Government in June 2021 (Climate Change Commission 2021). The Government now has a statutory responsibility to respond and to develop the emission reduction plan by the end of the year. The advice includes high-level guidance on the future of forestry, with strong suggestions that the Government should further modify the NZ ETS approach to forest removals and emissions. If the Government follows this advice, it will have to make further changes to the NZ ETS to ensure that more emphasis goes to establishing new indigenous forestry (with marginally less new plantation forestry) and that forestry offsets do not affect the incentives to reduce emissions in other sectors.

New Zealand is likely to have some need for international offsets to contribute to meeting its first Paris Agreement Nationally Determined Contribution (NDC). Meeting the national emission budgets recommended by the Climate Change Commission will put New Zealand's domestic emissions on a path that is consistent with the legislated goal of neutrality by 2050. However, the first and second emission budgets (up to 2030) allow for emissions that would exceed the NDC commitment. The Commission's

advice is therefore a signal that during the 2020s New Zealand may again become a net buyer of international offsets.

In comparison to the past, any such future use of international markets would have to meet very different expectations for environmental integrity. Article 6 of the Paris Agreement makes countries that engage in such co-operative action responsible for ensuring the integrity of transferred mitigation, and New Zealand's domestic legislation has been updated to include this responsibility.

4.5 Switzerland

4.5.1 State of play

Art. 6 of the CO_2-Act broadly defines quality requirements for units from Kyoto's Flexibility mechanisms, explicitly mentioning: additionality, the contribution of compensation projects to sustainable development in the host countries, and the absence of adverse social and ecological impacts. Further criteria are defined in annex 2 of the CO_2-Ordinance. This notably excludes projects involving biological or geological sequestration and hydropower from plants with installed capacities greater than 20 MW. In the 2013-2020 period, the origin of certificates was limited to Least Developed Countries for projects registered after 2012 (FOEN, 2015). Eligible projects are brought together on a project whitelist of the Swiss Emissions Trading Registry[6]. The projects included there meet the requirements set out in the revised CO_2 Ordinance of 1 January 2015 (see "Whitelist Information").

The possibility of using Kyoto units within the Swiss ETS (CH ETS) was excluded in the revised CO_2-law, valid as of 1 January 2021[7]. With this revision, all relevant emissions of the participating facilities must be covered by freely allocated or auctioned emissions rights alone. However, the use of Kyoto units remains an option within other policy instruments defined by the CO_2-Act outside the CH ETS; for instance, if a participant fails to fulfill the compensation obligation for motor fuels.

4.5.2 Relevant experience

Since its inception, the Swiss CO_2-Act allowed for the use of units from Kyoto's flexibility mechanisms (CDM and JI) within the CH ETS as well as the compulsory compensation scheme for fuel importers.[8] The use of offsets generated from domestic programs in the context of the CH ETS was never an option. The domestic emissions compensation scheme is solely relevant for compulsory compensation by motor fuel importers (see below).

During the period 2013-2020, the maximum share of Kyoto units as a fraction of total compliance units used by ETS participants was defined in the CO_2-Ordinance[9]. For companies which had already participated in the 2008-2012 period, this share was calculated from the allowances and Kyoto units used during these years: 8% of five times the yearly freely allocated emission units during the years 2008-2012, minus the number of Kyoto units used during this same time period. For new participants after 2013, a maximum share of 4.5% Kyoto units was eligible for compliance. Remaining emission allowances which were not used during the years 2008-2012 were converted "into emission allowances in accordance with" the then introduced CO_2-Ordinance[10].

During the period 2013-2018, about 94% of emissions were covered by freely allocated or auctioned emission allowances and 6% by Kyoto units (FOEN 2019). Given high allowance prices (between CHF 20 and 40) at the onset of the CH ETS 2013-2020 trading period, the purchase of much cheaper Cer-

6 www.emissionsregistry.admin.ch/crweb/public/whitelist/list.action

7 Federal Act on the Reduction of CO2 Emissions 641.71 (status as of 1 January 2021), https://www.fedlex.admin.ch/eli/cc/2012/855/en

8 Art. 5 of the Swiss CO_2 Act 641.71, https://www.fedlex.admin.ch/eli/fga/2012/14/de

9 Art. 55b of the Swiss CO2 Ordinance 641.711 (Status as of 1 November 2019), https://www.fedlex.admin.ch/eli/cc/2012/856/en

10 Art. 138 of the Swiss CO_2 Ordinance 641.711 (Status as of 10 February 2021), https://www.fedlex.admin.ch/eli/cc/2012/856/de

tified Emission Reductions (CERs), at a price around 0.9 EUR, was a viable strategy for market participants. Due to this large price discrepancy, even those companies which benefited from an overallocation of free permits, purchased additional CERs to cover their obligations. This resulted in large shares of CERs on the Swiss ETS market in 2013-2014: around 23% of the 2013 obligations were covered with Kyoto units (EFK, 2017). The quantitative limit on the use of offsets was then reached early during the trading period and the use of Kyoto-units became negligible after 2014 (FOEN, 2019).

Interactions with linking

As of 1 January 2020, the Swiss ETS has been fully linked to the EU ETS. Neither of the two markets allows for the use of international credits after 2020[11]. Already before 2020, the strong alignment of the Swiss ETS with the EU ETS led to analogous regulations concerning the use of Kyoto units. This includes, notably, the limitation on the units' origin to the Least Developed Countries (as defined by the United Nations) for projects registered after 2012. It also includes the upper limit of 4.5% for Kyoto units as a share of each company's total emissions obligation.

Other relevant experience with offsets

Switzerland is home to a domestic emission offsetting scheme. Since the first CO_2-act, 1 January 2013, motor fuel importing companies are required to compensate increasing shares of road transport sector emissions using domestic offset projects (2% in 2014, 12% in 2021[12]). To source these projects, the "Foundation for Climate Protection and Carbon Offset" (KliK) was established in 2013 by the Swiss Petroleum Association. The domestic offsetting system has been developed broadly along the lines of the UNFCCC's CDM. Projects are financed through monthly fees paid by participants in the carbon offset grouping. These fees follow from the amount of imported fuel, greenhouse gas abatement costs, and the compensation quota defined by the law. During the period 2013-2020, this scheme resulted in a surcharge on motor fuel oil for end-consumers of 1.5 cents per litre. The generated revenues enabled domestic emissions offsets of 6.3 million tons of CO_2-equivalent through payments of around CHF 100 per tonne (KliK 2020). The Federal Office for the Environment issues certificates to project owners for their yearly emission reductions, which can be sold to KliK or that can be traded on the Swiss market[13]. The projects are implemented in a broad range of sectors, such as transportation (electric and hybrid buses and utility vehicles, freight shift from road to rail), buildings (heat networks, wood-based heating, building automation) and others (e.g. nitrous oxide reduction in wastewater treatment plants, in agriculture, etc.) (KliK 2020; World Bank/PMR, 2015).

Public debate and future directions

According to the fully revised Swiss CO_2-Act, which is due later in 2021, up to a quarter of the 50% emissions reduction target by 2030 (relative to 1990) should be achieved through mitigation efforts abroad[14]. The KliK foundation (see above) was commissioned to procure the necessary 35 million tons of CO_2 equivalent reductions on behalf of Swiss transport fuel importers[15].

In order to establish an enabling framework for this goal and in line with article 6 of the Paris agreement, Switzerland implemented multiple bilateral agreements within the framework of Article 6.2. This was done notably with Peru and Ghana. These agreements serve as pilot projects with the stated aim of gaining experience (FOEN, 2020a; 2020b).

11 ec.europa.eu/clima/policies/ets/credits_en#tab-0-0

12 Art. 89 of the Swiss CO_2 Ordinance 641.711 (Status as of 10 February 2021), www.fedlex.admin.ch/eli/cc/2012/856/de#art_89

13 www.bafu.admin.ch/bafu/en/home/topics/climate/info-specialists/reduction-measures/compensation/in-switzerland.html

14 www.bafu.admin.ch/bafu/en/home/topics/climate/info-specialists/reduction-measures/compensation/abroad.html

15 www.international.klik.ch/news/publications/first-implementation-agreement-worldwide-under-the-paris-climate-agreement

The agreement with Peru was approved by the Swiss parliament in December 2020 and is considered to be the first of its kind in the world[16]. It provides the framework for the implementation of emission compensation projects. Even though the international climate negotiations under the UNFCCC did not yet succeed in completing the rules for Article 6, the Paris Agreement allows parties to enter bilateral agreements under Article 6.2. These agreements define specific criteria for assuring the quality and environmental integrity of expected internationally transferred mitigation outcomes (ITMOs), and for reducing the risk that these projects will cause environmental damage and human rights violations (Swiss Confederation and Republic of Peru, 2020; FOEN, 2020b). Important, the agreement incorporates accounting methods to exclude double counting. Switzerland's Article 6 activities are also in line with the San Jose Principles for Article 6 activities. Besides Peru, a similar cooperation was put in place with Ghana[17]. The specific activities to be implemented within the framework are yet to be defined. However, first steps were taken prior to the agreement with the Peruvian program "Tuka Wasi". This distributes improved cookstoves, and the program helped to inform the design decisions of the agreement[18].

Since, as of 2021, the Swiss ETS excludes the use of foreign allowances, no direct interaction between the domestic trading system and these bilateral agreements is envisaged. Furthermore, annex 2 of the CO_2-act again limits the origin of international mitigation units usable in any of its policy instruments to Least Developed Countries.

5. Discussion and conclusions

Well-designed offsets to boost climate action

Keeping the global average temperature increase well below 2 °C (the target of the Paris Agreement) will require some countries to hit an implicit carbon price of roughly $100/tonne of CO_2 by 2030 (IETA and University of Maryland, 2019). While allowance prices have been rising in all operational ETSs involved in the CMPD during the last year, with the EUAs reaching almost €57 in May, the $100/tonne of CO_2 remains a tough challenge. ETS regulators might want to include offsets within their systems as the appetite for reducing compliance costs will likely increase over time, regardless of considerations about international cooperation and support of developing countries. In fact, emission offsets will very likely be needed to achieve increasingly ambitious climate goals. It is, therefore, fundamental to understand what offsets provisions can allow for enhanced cost-efficiency while safeguarding environmental integrity.

The scientific literature has identified a number of measures that would be useful for ensuring the environmental integrity of offsets in the context of an ETS. First, scholars have recommended to only consider projects that prove themselves financially unsustainable without crediting funds (Cames et al., 2016; Claassen et al., 2014). The reason is that projects with returns on investment that are already competitive relative to the market would be implemented anyway, i.e. even without crediting. As such, they would not be additional. Secondly, project-type or sector-specific methodologies are preferable to generic one-size-fits-all criteria addressing all project types (Cames et al., 2016). Still, some over-crediting could arise given potential pressure on policymakers from project developers and even from credit buyers (Haya et al., 2020). This is indeed the approach adopted by the California and Quebec regulators. Thirdly, in the context of an ETS with a fixed cap, scholars suggest that credits should not be used to de facto increase the cap. This implies that for every emission credit used in the system, an emission permit would have to be cancelled. Furthermore, the role of offsets should be minor and international credits should mainly come from mitigation activities in developing countries (Haya et al., 2020; Cames et al., 2016).

16 www.bafu.admin.ch/bafu/en/home/documentation/news-releases/anzeige-nsb-unter-medienmitteilungen.msg-id-80708.html

17 https://www.bafu.admin.ch/bafu/en/home/topics/climate/info-specialists/reduction-measures/compensation/abroad/host-countries.html

18 tukiwasi.org/en/

Overall, adherence to these guidelines reflects a commitment to environmental integrity and, therefore, to environmental ambition too. The scientific literature does not identify technical barriers to linking ETSs with different offset provisions. However, it seems politically difficult and implausible to link systems whose offset provisions reflect very different levels of environmental ambition (see Verde et al., 2020).

The crucial pieces of Article 6

The market-based mechanisms under Article 6 of the Paris Agreement could play a decisive role in fostering the integration of carbon markets. The possibility of exchanging mitigation outcomes between parties may yield sizable cost savings, which a recent study has estimated at about $250 billion per year by 2030 for achieving the 2 °C target of the Paris Agreement (IETA and University of Maryland, 2019). Besides, if these savings were channelled to enhance mitigation efforts, an additional 520 $GtCO_2$ could be abated. According to the same study, if all countries participated in a common market-based mechanism, the carbon price requirement to achieve the 2 °C target would be much lower, staying at about $38 in 2030 and only rising to $107 by 2050. However, the environmental integrity of systems linking with this common carbon market would hinge on the specific rules contained in the Paris Rulebook, which is yet to be agreed by Parties (see Schneider and La Hoz Theuer, 2019).

First of all, it is important to stress the difference between unconditional and conditional NDCs (see Section 2.3) and its implications for the trade of ITMOs. Intuitively, allowing countries to sell ITMOs while not having achieved their own unconditional NDC, would likely jeopardise the environmental effectiveness of the whole system. Similarly, on the demand side, it could be argued that Parties should tackle unconditional targets with national policies and that they should only be allowed to use ITMOs to cover their conditional and more ambitious NDCs (Carbon Market Watch, 2020; Spalding-Fecher et al., 2017). The diverse nature of the NDCs adds to their complexity, as some of them are not expressed in terms of CO_2 abatement (absolute targets), but rather as carbon intensity (relative targets) or as climate-related objectives[19] (indirect targets) (Schneider and Laz Hoz Theuer, 2019). Against this background, understanding the extent to which one 'mitigation unit' is in excess of the unconditional NDC is even more challenging. At present, the very nature of ITMOs and the way they are to be exchanged are uncertain (La Hoz Theuer et al., 2019).

Secondly, and particularly relevant for this report, ETS regulators might consider admitting ITMOs as compliance units and exchanging them between linked systems. As long as the use of ITMOs under ETSs is not in excess of the cap (if there is a cap) and the mitigation outcomes transferred only involve activities covered by the systems (i.e. they are represented by allowances), this would ensure exchanges with high environmental integrity (Schneider and La Hoz Theuer, 2019). However, this could increase demand for allowances in those ETSs whose allowance prices are lower, thus putting its carbon market under pressure. Similarly to what is proposed for import of allowances between linked ETSs (Lazarus et al., 2015), limits on the number of ITMOs that can be exchanged by each jurisdiction could effectively contain this problem. The flip side is reduced participation in the global carbon market and thus reduced trade gains (La Hoz Theuer et al., 2019; Gavard et al., 2016). If this solution were to be investigated, allocating a maximum number of ITMOs that can be issues, transferred, or acquired could be more effective and simpler than quantitative limits based on historical or projected (BAU) emissions (La Hoz Theuer et al., 2019). If one ETS opens to admitting ITMOs from activities not covered by an ETS (i.e. they are not allowances), its environmental integrity depends on the safeguards agreed upon in the Paris Rulebook. Unless robust eligibility criteria are applied, this could undermine linking negotiations, due to concerns over environmental integrity.

Thirdly, many NDCs pledges are expressed in terms of single-year targets, e.g. emissions abated in 2030 with respect to historical emissions. However, the financial cycle of offset projects typically involves different time spans and credits issuance occurs over multi-year periods. Aligning the time frames of NDCs with the ones of offset projects is important for a robust accounting of emissions and to accurately assess the mitigation outcomes. This is especially relevant to limiting exchanges of mitiga-

19 For instance, the share of final energy consumption from Renewable Energy Sources.

tion outcomes to the over-achievement of NDCs (Schneider and La Hoz Theuer, 2019; Spalding-Fecher et al., 2017; Cames et al., 2016).

Finally, voluntary carbon markets (VCMs) deserve a special mention. The above-mentioned distinction between unconditional and conditional NDCs has implications for the admissibility of Voluntary Emission Reductions (VERs) towards the achievement of NDCs. While there is little uncertainty that cooperation and financing mechanisms (including VCMs) may be employed in pursuit of conditional pledges, it is not clear whether they could also be used for the fulfillment of unconditional pledges. Avoidance of double counting and the principle of additionality would require VERs purchased and claimed by a firm not to be ascribable towards the fulfillment of national NDCs. As such, VCMs could either give rights to claim international support, instead of emission abatement, or be limited towards the fulfilment of conditional pledges (Leining and White, 2021; Stahlke, 2020; Spalding-Fecher et al., 2017). Operators developing offsetting projects for the VCMs took different stances on these issues: while Gold Standard acknowledged the need for a corresponding adjustment for emissions covered by the Paris Agreement, Verra argued against it (Carbon Pulse, 2021; Gold Standard, 2021; Verra, 2021).

Low-hanging fruits vs scaffolding investments

The Paris Agreement reiterates the principle that countries have “common but differentiated responsibilities” and that “support should be provided to developing countries”. Participation in the market-based mechanisms under Article 6 could channel valuable resources to developing countries, where emissions abatement is cheaper than in industrialised countries. However, to ensure that these resources actually support the transition to a low-carbon economy in developing countries, long-term impacts on emissions abatement costs are fundamental. If the financial resources under the Article 6 market-based mechanism are directed towards low-hanging fruit – i.e. the cheapest or simplest abatement options – it could make achievement of the NDCs much more difficult for developing countries. The experience with the CDM shows that projects increased their abatement cost for developing countries, which in turn reduced mitigation efforts by hosting national legislators (Stahlke, 2020). In theory, this reduction in mitigation efforts might be addressed through making NDCs mandatory (e.g. sanctioning non-compliant entities) or through enhancing offset projects with valuable co-benefits for developing countries (Stahlke, 2020).

Another possibility would be to use the $100 billion fund that industrialised countries committed to raise in support of mitigation and adaptation activities in developing countries. At the time of writing, however, the target is still unmet. The financial support requested by developing countries and least developed island nations far exceeds the $100 billion fund, even if it were to be renewed until 2030 (Pauw et al., 2020). These financial resources could significantly help developing countries in reducing their abatement costs, at least partially compensating for the increase induced by the sale of ITMOs under the market-based mechanism of Article 6. If a quantitative absolute limitation were to be imposed on participation in the market-based mechanism (as suggested in La Hoz Theuer et al., 2019, Schneider and La Hoz Theuer, 2019, and Gavard et al., 2016), the effect on marginal abatement costs of developing countries could be contained. This would be done at the price of lower climate benefits on a global scale, however (La Hoz Theuer et al., 2019). A more general principle concerning the use of ITMOs and offsets by industrialised countries would be to use emission offset to abate ‘residual’ (i.e. hard to abate) emissions, rather than to substitute for domestic mitigation. Another pathway would be to qualitatively limit crediting to projects aimed at closing a specific technological gap, empowering developing countries to abate at a lower cost in the future, while also providing co-benefits in the form of knowledge spillovers.

Reference list (APA style)

Alessi, M., & Fujiwara, N. (2011). Briefing paper "JI Track 1 preliminary assessment".

Anaya, S. J. (2009). Observaciones sobre la situación de la comunidad Charco la Pava y otras comunidades afectadas por el proyecto hidroeléctrico Chan 75 (Panamá). Panama City, Panama: United Nations.

Anderson, C. M., Field, C. B., & Mach, K. J. (2017). Forest offsets partner climate□change mitigation with conservation. Frontiers in Ecology and the Environment, 15(7), 359-365.

Ares (2020), Inception impact assessment for the revision of the EU Emission Trading System Directive 2003/87/EC concerning aviation. Brussels: European Commission.

Barber, J. (2008). Paradigms and perceptions: A chronology and analysis of the events of the Chan-75 hydroelectric project and the roles and relationships of participants, Bocas del Toro, Panama.

Beuermann, C., Bingler, J., Santikarn, M., Tänzler, D., & Thema, J. (2017). Considering the effects of linking emissions trading schemes: A manual on bilateral linking of ETS. Berlin: German Emissions Trading Authority (DEHSt) at the German Environment Agency.

Bird, A. (2013). Human rights violations attributed to military forces in the Bajo Aguan Valley in Honduras. Rights Action.

Burtraw, D., Palmer, K. L., Munnings, C., Weber, P., & Woerman, M. (2013). Linking by degrees: Incremental alignment of cap-and-trade markets. Resources for the Future DP, 13-04.

Cames, M., Harthan, R. O., Füssler, J., Lazarus, M., Lee, C. M., Erickson, P., & Spalding-Fecher, R. (2016). How additional is the clean development mechanism. Analysis of the application of current tools and proposed alternatives.

Carbon Market Watch (2020). Above and Beyond Carbon Offsetting: Alternatives to Compensation for Climate Action and Sustainable Development. Policy briefing.

Carbon Pulse. (2021). Verra will not require corresponding adjustments for voluntary offset transactions, https://carbon-pulse.com/127198/, last accessed 16 September 2021.

Carver, T., Dawson, P., & Kerr, S. (2017). Including forestry in an emissions trading scheme: Lessons from New Zealand. Available at SSRN 3015082.

CDM Watch (2011) 'Open letter to UK: UK government must withdraw authorisation for Aguan and Lean CDM projects linked to assassinations and other human rights abuses in Honduras', 14 February, https://carbonmarketwatch.org/wp-content/uploads/2011/02/4_Feb_2011_Open_Letter_to_UK_Government.pdf, accessed 16 September 2021.

Chatterjee, B. (2011). Briefing paper "Technology Transfer through the Clean Development Mechanism (CDM)".

Claassen, R., Horowitz, J., Duquette, E., & Ueda, K. (2014). Additionality in US agricultural conservation and regulatory offset programs. USDA-ERS Economic Research Report, (170).

Cournil, C., & Tabau, A. S. (2012). Human rights and climate change: EU policy options. European Parliament.

Crowe, T. L. (2013). The potential of the CDM to deliver pro-poor benefits. Climate Policy, 13(1), 58-79.

Cultural Survival (2007), "Dam Nation", authored by Ellen L. Lutz, available online at https://www.culturalsurvival.org/publications/cultural-survival-quarterly/dam-nation

Dai, Y., Bie, Z., Wu, Q., Deng, J., & Jiang Y. (2019). A study on carbon emission trading system based on liquidity. Business Theory of China, (12), 208-210.

de Alegría, I. M., Fernández-Sainz, A., Alvarez, I., Basañez, A., & del-Río, B. (2017). Carbon prices: Were they an obstacle to the launching of emission abatement projects in Spain in the Kyoto Protocol period?. Journal of Cleaner Production, 148, 857-865.

Diaz-Rainey, I., & Tulloch, D. J. (2018). Carbon pricing and system linking: lessons from the New Zealand emissions trading scheme. Energy Economics, 73, 66-79.

du Monceau, T., & Brohé, A. (2011). Briefing paper "Baseline Setting and Additionality Testing within the Clean Development Mechanism (CDM)". London: AEA.

du Monceau, T., Brohé A. CO2logic, & Fujiwara, N. (2011). Briefing paper "Political Lock-in in the context of the CDM".

Dulaney, S., Greenbaum, E., Hunt, J., & Manya, D. (2017). Carbon Offsets and Health Co-Benefits.

Eidgenössische Finanzkontrolle (EFK). (2017). Evaluation der Lenkungswirkung des Emissionshandelssystems Bundesamt für Umwelt, https://www.efk.admin.ch/images/stories/efk_dokumente/publikationen/evaluationen/Evaluationen%20(51)/16393BE.pdf, last accessed 16 September 2021.

European Parliament and the Council of the EU, 2004, 'Directive 2004/101/EC of the European Parliament and of the Council of 27 October 2004 amending Directive 2003/87/EC establishing a scheme for greenhouse gas emission allowance trading within the Community, in respect of the Kyoto Protocol's project mechanisms', Official Journal of the European Union L338, 18–23.

Federal Office for the Environment (FOEN) 2015, Fact sheet: Quality of the Emission Reductions Achieved Abroad, web.archive.org/web/20200823061628/https://www.bafu.admin.ch/dam/bafu/en/dokumente/klima/formular/qualitaet_von_imauslanderzieltenemissionsverminderungen.pdf.download.pdf/quality_of_the_emissionreductionsachievedabroad.pdf

Federal Office for the Environment (FOEN) 2019, Überblick Emissionshandel für stationäre Anlagen 2013-2018 (Overview Emission Trading for stationary installations 2013-2018), web.archive.org/web/20210323071528/https://www.bafu.admin.ch/dam/bafu/de/dokumente/klima/fachinfo-daten/Ueberblick-Emissionshandel-fuer-stationaere-Anlagen-2013%E2%80%932017.pdf.download.pdf/%C3%9Cberblick_Emissionshandel_f%C3%BCr_station%C3%A4re_Anlagen_2013-2018.pdf

Federal Office for the Environment (FOEN). (2020a). Cooperation Agreement Switzerland-Ghana Implementation Paris Agreement, https://www.bafu.admin.ch/dam/bafu/en/dokumente/international/fachinfo-daten/Cooperation%20Agreement%20CH-Ghana%20Implementation%20Paris%20Agreement.pdf.download.pdf/Cooperation%20Agreement%20CH-Ghana%20Implementation%20Paris%20Agreement.pdf, last accessed on 16 September 2021.

Federal Office for the Environment (FOEN). (2020b). Joint Statement on bilateral Cooperation under the Article 6 of the Paris Agreement, https://www.bafu.admin.ch/dam/bafu/en/dokumente/international/fachinfo-daten/JointStatement_Implementing_Agreement_Article6_Paris%20Agreement_Switzerland-Peru.pdf.download.pdf/JointStatement_Implementing_Agreement_Article6_Paris%20Agreement_Switzerland-Peru.pdf, last accessed on 16 September 2021.

FIDH, FIAN, Via Campesina, APRODEV, CIFCA, Rel-UITA (2011). Human Rights Violations in Bajo Aguan. Paris: FIDH, https://www.fidh.org/IMG/pdf/honduras573ang.pdf, accessed 24/05/2021.

Finley-Brook, M., & Thomas, C. (2010). Treatment of displaced indigenous populations in two large hydro projects in Panama. Water Alternatives, 3(2), 269.

Frank, Dana (2011) 'WikiLeaks Honduras: US linked to brutal businessman', The Nation, 21 October, http://www.thenation.com/article/164120/wikileaks-honduras-us-linkedbrutal-businessman, accessed 15 September 2021.

Freeman, O. E., & Zerriffi, H. (2012). Carbon credits for cookstoves: Trade-offs in climate and health benefits. The Forestry Chronicle, 88(5), 600-608.

Fu, J., Zhang, Y., & Xie, Z (2017). Does the Mechanism Design Influence Carbon Market's Liquidity?-A

Research Based on China's Pilot Regions. Finance & Trade Economics, 8, 129-143.

Gavard, C., Winchester, N., & Paltsev, S. (2016). Limited trading of emissions permits as a climate co-operation mechanism? US–China and EU–China examples. Energy Economics, 58, 95-104.

Glemarec, Y., Qayum, S., & Olshanskaya, M. (2016). Leveraging co-benefits between gender equality and climate action for sustainable development: Mainstreaming Gender Considerations in Climate Change Projects. UN Women.

Gold Standard. (2021). Integrity For Scale: Aligning Gold Standard-Certified Projects With The Paris Agreement, https://www.goldstandard.org/sites/default/files/documents/integrity_for_scale_aligning_gs_certified_projects_with_the_paris_agreement.pdf, last accessed 16 September 2021.

Hawkins, S., & Jegou, I. (2014). Linking Emissions Trading Schemes. Considerations and Recommendations for a Joint EU-Korean Carbon Market. ICTSD Global Platform on Climate Change, Trade and Sustainable Energy.

Hawkins, S., & Jegou, I. (2014). Linking Emissions Trading Schemes. Considerations and Recommendations for a Joint EU-Korean Carbon Market. ICTSD Global Platform on Climate Change, Trade and Sustainable Energy.

Haya, B., Cullenward, D., Strong, A. L., Grubert, E., Heilmayr, R., Sivas, D. A., & Wara, M. (2020). Managing uncertainty in carbon offsets: insights from California's standardized approach. Climate Policy, 20(9), 1112-1126.

Haya, B. (2019). Policy brief: The California Air Resources Board's US Forest offset protocol underestimates leakage. Center for Environmental Public Policy, University of California, Berkeley, https://gspp. berkeley. edu/assets/uploads/research/pdf/Policy_Brief-US_Forest_Projects-Leakage-Haya_2. Pdf.

He, G., & Morse, R. (2013). Addressing carbon offsetters' paradox: lessons from Chinese wind CDM. Energy Policy, 63, 1051-1055.

Hultman, N., Lou, J., & Hutton, S. (2020). A review of community co-benefits of the Clean Development Mechanism (CDM). Environmental Research Letters, 15(5), 053002.

International Emissions Trading Association (IETA) and University of Maryland. (2019). The Economic Potential of Article 6 of the Paris Agreement and Implementation Challenges. Washington, D.C.

Inter-American Commission on Human Rights (IACHR). 2009a. Case 12.717/ precautionary measure PM56/08— Indigenous communities Ng¨obe and others, Panama participants: Cultural Survival, State of Panama. Panama City, Panama: IACHR.

Jordan, O. (2014). " I Entered During the Day, and Came Out During the Night": Power, Environment, and Indigenous Peoples in a Globalizing Panama. Tennessee Journal of Law and Policy, 4(2), 10.

Kachi, A., Unger, C., Böhm, N., Stelmakh, K., Haug, C., & Frerk, M. (2015). Linking emissions trading systems: A summary of current research. International Carbon Action Partnership.

Karlsson, M., Alfredsson, E., & Westling, N. (2020). Climate policy co-benefits: a review. Climate Policy, 20(3), 292-316.

KliK 2020, Annual Report 2019 of the Foundation for Climate Protection and Carbon Offset KliK, web.archive.org/web/20210331052514/https://www.annualreport.klik.ch/resources/AR19-E-KliK_Foundation_200610.pdf

Kollmuss, A., Schneider, L., & Zhezherin, V. (2015). Has joint implementation reduced GHG emissions?: lessons learned for the design of carbon market mechanisms. Stockholm Environment Institute..

Kuriyama, A., & Abe, N. (2018). Ex-post assessment of the Kyoto Protocol–quantification of CO2 mitigation impact in both Annex B and non-Annex B countries. Applied Energy, 220, 286-295.

La Hoz Theuer, S., Schneider, L., & Broekhoff, D. (2019). When less is more: Limits to international transfers under Article 6 of the Paris Agreement. Climate Policy, 19(4), 401-413.

Lazarus, M., Schneider, L., Lee, C., & van Asselt, H. (2015). Options and issues for restricted linking of emissions trading systems. ICAP, September.

Lazarus, M., & Chandler, C. (2011). Coal power in the CDM: Issues and options. Stockholm Environment Institute.

Lehmann, I. (2019). When cultural political economy meets 'charismatic carbon' marketing: A gender-sensitive view on the limitations of gold standard cookstove offset projects. Energy Research & Social Science, 55, 146-154.

Leining, C. & White, D. (2021). Boosting voluntary climate action in Aotearoa New Zealand, Motu Economic and Public Policy Research.

Li, F., Wang W., & Yan T. (2018). The Offset Mechanism of China's Pilot Carbon Markets. Research on Economics and Management, 39(12), 94-103.

Li, L., Ye, F., Li, Y., & Chang, C.-T. (2019). How will the Chinese Certified Emission Reduction scheme save cost for the national carbon trading system?. Journal of Environmental Management, 244(15), 99-109.

Lu, J. (2019). The Drivers of Carbon Prices and Management System in China. Phd Thesis. Jilin University of China

Mason, C. F., & Plantinga, A. J. (2012). The additionality problem with offsets: Optimal contracts

for carbon sequestration in forests. Journal of Environmental Economics and Management, 64, 288-300.

Mehling, M., & Haites, E. (2009). Mechanisms for linking emissions trading schemes. Climate Policy, 9(2), 169-184.

Michaelowa, A. (2012). Determination of baselines and additionality for the CDM: A crucial element of credibility of the climate regime. In Climate Change and Carbon Markets (pp. 329-344). Routledge.

Mori-Clement, Y., & Bednar-Friedl, B. (2019). Do clean development mechanism projects generate local employment? Testing for sectoral effects across Brazilian municipalities. Ecological economics, 157, 47-60.

Nyaoro, J., & Chatterjee, B. (2011). Briefing Paper'Governance on the Clean Development Mechanism (CDM). AEA Technology, ED56638, Issue, (1).

Pauw, W. P., Castro, P., Pickering, J., & Bhasin, S. (2020). Conditional nationally determined contributions in the Paris Agreement: foothold for equity or Achilles heel?. Climate policy, 20(4), 468-484.

Purdon, M., Houle, D., & Lachapelle, E. (2014). The political economy of California and Quebec's cap-and-trade systems. Sustainable Prosperity (University of Ottawa).

Rao Xin. Research on Price Fluctuation Transmission Mechanism of Carbon Emission Trading Market in Guangdong Province. Phd Thesis. China University of Geosciences (Beijing),2019.

Ruthner, L., Johnson, M., Chatterjee, B., Lazarus, M., Fujiwara, N., Egenhofer, C., ... & Brohe, A. (2011). Study on the integrity of the Clean Development Mechanism (CDM). Final Report. European Commission. London: Centre for European Policy Studies–CEPS.

Santikarn, M., Li, L., La Hoz Theuer, S., & Haug, C. (2018). A guide to linking emissions trading systems, ICAP: Berlin.

Schade, J., & Obergassel, W. (2014). Human rights and the clean development mechanism. Cambridge Review of International Affairs, 27(4), 717-735.

Schneider, L. (2009). Assessing the additionality of CDM projects: practical experiences and lessons learned. Climate Policy, 9(3), 242-254.

Schneider, L. R. (2011). Perverse incentives under the CDM: an evaluation of HFC-23 destruction projects. Climate Policy, 11(2), 851-864.

Schneider, L., & Kollmuss, A. (2015). Perverse effects of carbon markets on HFC-23 and SF 6 abatement projects in Russia. Nature Climate Change, 5(12), 1061-1063.

Schneider, L., Cludius, J., & La Hoz Theuer, S. (2018). Accounting for the linking of emissions trading systems under Article 6.2 of the Paris Agreement. Berlin: International Carbon Action Partnership (ICAP).Spalding-Fecher, R., Sammut, F., Broekhoff, D., & Füssler, J. (2017). Environmental integrity and additionality in the new context of the Paris Agreement crediting mechanisms. Carbon Limits.

Stahlke, T. (2020). The impact of the Clean Development Mechanism on developing countries' commitment to mitigate climate change and its implications for the future. *Mitigation and Adaptation Strategies for Global Change*, 25(1), 107-125.

Tanjiaoyi (2021) Study and analysis of carbon market allowance and CCER price. http://www.tanjiaoyi.com/article-32814-1.html

Swiss Confederation and Republic of Peru, 2020, Implementing agreement to the Paris Agreement between the Swiss Confederation and the Republic of Peru, https://www.bafu.admin.ch/dam/bafu/en/dokumente/international/fachinfo-daten/Implementing%20Agreement%20to%20the%20Paris%20Agreemen_%20PE_CH_Signed.pdf.download.pdf/Implementing%20Agreement%20to%20the%20Paris%20Agreemen_%20PE_CH_Signed.pdf

Swiss Federal Audit Office (EFK), 2017, Evaluation der Lenkungswirkung des Emissionshandelssystems (Incentive effect of emissions trading scheme), web.archive.org/web/20210331071623/https://www.efk.admin.ch/images/stories/efk_dokumente/publikationen/evaluationen/Evaluationen%20%2851%29/16393BE.pdf

Thamo, T., & Pannell, D. J. (2016). Challenges in developing effective policy for soil carbon sequestration: perspectives on additionality, leakage, and permanence. Climate Policy, 16(8), 973-992.

The World Bank/Partnership for Market Readiness (PMR), 2015, Overview of Carbon Offset Programs: Similarities and Differences, web.archive.org/web/20210308092406/https://openknowledge.worldbank.org/bitstream/handle/10986/21353/COP_eBook.pdf

Torres, A. B., MacMillan, D. C., Skutsch, M., & Lovett, J. C. (2015). Reprint of 'Yes-in-my-backyard': Spatial differences in the valuation of forest services and local co-benefits for carbon markets in México. Ecological economics, 117, 283-294.

Trotignon, R. (2012). Combining cap-and-trade with offsets: lessons from the EU-ETS. Climate Policy, 12(3), 273-287.

Trotignon, R., & Delbosc, A. (2008). Allowance trading patterns during the EU ETS trial period: What does the CITL reveal. Climate report, 13, 1-36.

Tuerk, A., Mehling, M., Flachsland, C., & Sterk, W. (2009). Linking carbon markets: concepts, case studies and pathways. Climate Policy, 9(4), 341-357.

United Nations Development Programme (UNDP) (2016). Ensuring gender equity in climate change financing, https://www.undp.org/sites/g/files/zskgke326/files/publications/EngendCC_7.pdf, last accessed on 16 September 2021.

Unruh, G. C. (2000). Understanding carbon lock-in. Energy policy, 28(12), 817-830.

Verde, S. F., & Chiaramonti, D. (2021). The biochar system in the EU: the pieces are falling into place, but key policy questions remain.

Verde, S. F., Galdi, G., Borghesi, S., Füssler, J., Jamieson, T., Wimberger, E., & Zhou, L. (2020). Emissions trading systems with different levels of environmental ambition: implications for linking-Report for the Carbon Market Policy Dialogue. European University Institute.

Verra. (2021). The Future of the Voluntary Carbon Market, https://verra.org/the-future-of-the-voluntary-carbon-market/, last accessed 16 September 2021.

WOCAN (2021). How the scaling of voluntary carbon markets can amplify gender equality impacts, https://www.wocan.org/sites/default/files/White%20Paper-%20W%2B%20carbon%20markets%20.pdf. Last accessed on the 15 September 2021.

Zetterberg, L. (2012). Linking the emissions trading systems in EU and California. Fores.

Zhao, Z., Tian, M., Li, J., & Gu, H.-Y. (2018). Research on cooperative development of carbon permits trading and forestry carbon sink based on offset mechanism. Journal of Shanghai Jiaotong University (Agricultural Science), 36(2), 90-98.

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