34 Harnessing the animal spirits of finance for a low-carbon transition

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This chapter starts from an apparent contradiction between the quest for upgrading the funding for a low-carbon transition and the constraints impinging upon the world economy in the aftermath of the 2008 financial crisis. It argues that new financial tools are needed to remove this contradiction and trigger a massive wave of low-carbon investments, and explains why carbon prices alone cannot do the job. It points out that, in the absence of a benevolent lender, high upfront costs of low-carbon projects under uncertainty about the cost of equipment and the duration of the maturation phase of the projects mean that investments which could be profitable are frozen. The creation of Climate Remediation Assets (CRAs) based on a governments' public guarantee, along with carbon pricing, would remove this barrier to investing in low-carbon activities. Based on this guarantee, project developers can obtain carbon certificates from their banks and reimburse them in certified emission reductions and not in cash. This is possible because the central bank provides the banking system with liquidity corresponding to the carbon certificates which, once recuperated by the central bank, appear as CRAs on its balance sheet. The chapter then discusses how, by creating a new vehicle suitable for bridging long-term assets and short-term cash balances, CRA-based devices could both trigger a low-carbon transition and help drive the world economy out of the current state of doldrums and instability.

1 Introduction

Time is running out to act on climate change; it is also running out to act on poverty eradication and sustainable development. These challenges cannot be met independently from each other, because there will be no involvement of developing countries if climate policies slow down their exit from poverty, and because climate change might create tensions that make development unsustainable. This is why we have to resist the temptation to postpone significant climate action until the end of the current adverse economic context. Finance, the key constraint in the aftermath of the 2008 crisis, cannot but be part of the solution. This chapter explores how.

Paradoxically, given its influence on our economies, finance has until recently been a minor topic in climate negotiations. One exception was the Brazilian proposal in 1997 for a compliance fund to implement the common but differentiated responsibility (CBDR) principle (UNFCCC 1997). This was symptomatic of doubts of non–Annex 1 countries about the willingness of Annex 1 countries to make the transfers[1] needed to compensate for the impacts of significant carbon prices on their economies.[2] COP16 in Copenhagen (in 2009) marked a turning point by establishing a Green Climate Fund (GCF), but it did so in a context where pressures on public budgets and a fragile economic recovery in OECD countries had exacerbated 'donor fatigue'. Discussions on the GCF are at risk of remaining an adversarial exercise between the 'North' and the 'South' and of missing the key challenge, which is the redirection of investments all over the world towards a low-carbon transition of an order of magnitude beyond what can be expected from public finance.[3]

Section 1 shows why, to overcome these drawbacks, the 'mental map' of policy analysts must account for the time profile of investments needed to achieve a low-carbon transition and also incorporate finance in the toolkit of incentives to be mobilised. Section 2 suggests reforms of the prevailing financial intermediation

1 Limits to these transfers were an implicit motivation of the Byrd-Hagel resolution of the US Senate (1997) (see http://www.nationalcenter.org/KyotoSenate.html) and of the EU request of 'concrete ceilings' to imports of emissions allowances through cap-and-trade systems (see Hourcade and Ghersi 2002).

2 These impacts are high in countries that are still in a development phase and require energy-intensive materials to build basic infrastructures (Luderer et al. 2012).

3 The global estimated need in infrastructure investments between now and 2030 is US$89 trillion, rising to $93 trillion if climate is to be properly addressed (New Climate Economy 2014). The major challenge is obviously the redirection of a large fraction of the $89 trillion.

through the creation of carbon assets valued at an agreed notional price of mitigation activities. Section 3 shows how these reforms can help drive the world economy out of the current economic doldrums and gain support for climate policies from climate-agnostic policymakers in charge of economic policies who are focused on the short-term challenges of employment and debt reduction.

2 Finance and carbon pricing

The Kyoto Protocol was the outcome of a succession of diplomatic *faits accomplis* (Bodansky 2001) with many possible interpretations. The dominant interpretation was governed by a mental map in which a world carbon market would connect *abatement cost curves* all over the world and *select-cost-efficient techniques* given the uniform carbon price imposed on all the carbon emitters.

The difficulties in establishing a world cap-and-trade system generated an extensive literature on the wedges between technical costs, GDP variations, and welfare variations.[4] Less attention has been dedicated to the fact that, in the models establishing the superiority of this policy tool, technologies are assumed to be selected according to their present expected value for a given discount rate. This ranking is made regardless of the time profile of the operating costs of projects. This amounts to an assumption of unlimited access to financing, which seems quite unrealistic.

Figure 1 depicts the time profile of the expected operating accounts of two example projects. Project A, with a capital-intensive technology, has a higher expected present value (i.e. the discounted sum of lower purchase of fossil fuels minus the capital expenditures and operational costs) than project B, but it might not be selected because of its higher upfront costs. During the incubation phase of the project, a bad surprise regarding these costs (indicated by the dashed lines) might indeed generate a deficit of operating accounts beyond a 'danger line', D, i.e. the level of deficit the decision-maker does not want to cross. These bad surprises can come from a mismanagement of

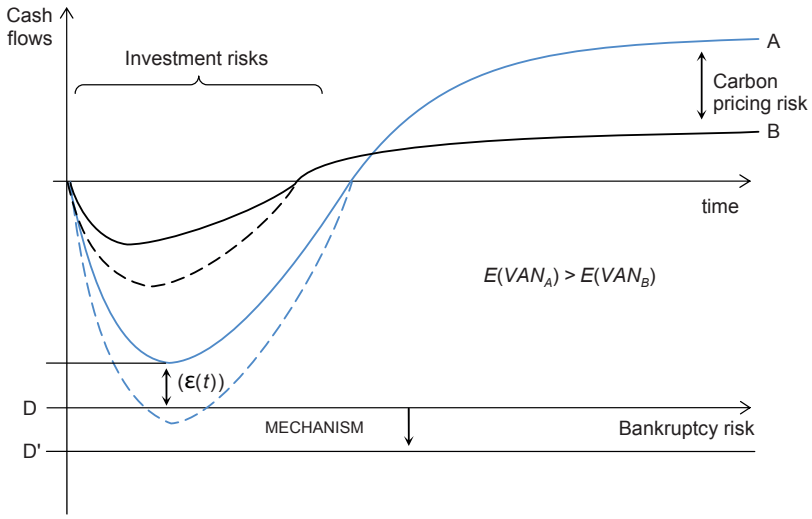
4 These wedges come from the propagation of higher energy prices throughout the economies, uncertainty about the efficiency of the compensatory transfers, incomplete and fragmented markets (energy, labour, real estate) and pre-existing fiscal systems.

projects, a cost increase for certain equipment, or a discovery of technical difficulties in non-mature technologies.

This situation is typical of households that require very short payback periods for their investments in energy efficiency. This is also the case of firms with limited access to finance (be it via debt, equity or self-finance). In the absence of a benevolent lender with unlimited lending capacities, onerous debt-servicing lowers their operating surpluses and poses a threat to dividend payments to their shareholders if their bank loses confidence. Ultimately, the value of the firm might be affected, with a risk of bankruptcy or hostile takeover.

Carbon pricing improves the relative efficiency of low-carbon projects, but it does so during the operation phase only for projects not stifled by the existence of the 'danger line'. One can argue that sufficiently high carbon prices could encourage decision-makers to take the risk. But they would have to be very high because the cost of approaching and crossing the danger line is highly non-linear and because they would have to cover the 'noise' of other unfavourable signals (such as real estate prices, oil prices and exchange rates) indicated by ε(t) in Figure 1. Financial devices are thus needed to move the 'danger line' (from D to D′), to decrease the risks arising from overruns of upfront investment costs, and to increase the effect of carbon pricing.

Figure 1 Investment risks, finance and carbon pricing



The existence of this danger line does not only constrain low-carbon projects, it characterises a business environment in which managers have to pay close attention to the short-term value of the firm. In this 'shareholder business regime' (Roe 1994),[5] managers do not have full latitude to use the net profits of their firm to maximise its long-term growth. Put simply, investors face a 'Buridan's ass' dilemma.[6] They pay no attention to which direction long-term investments should go, and are not helped by the difficulty of the present system of financial intermediation to fund productive investments. Ultimately, private savers are reluctant to maintain investment rates in the industry, preferring instead speculative or liquid assets. This interplay between financial factors and heightened uncertainty (Lewis 2014) is now recognised as having a prominent role in the gap between real growth and potential growth, and in a chronic excess of savings over investments (Blanchard 2015). The question, then, is whether there exist financial devices designed to support low-carbon investments that can reduce this gap.

3 Towards the creation of Climate Remediation Assets (CRAs)[7]

To understand the type of mechanism suitable to operate this redirection of investments, it is useful to remember historical examples of links between finance and deep technological revolutions. In the nineteenth century, the impressive deployment of railways was unleashed thanks to various (country-specific) forms of public guarantees on investments and the creation of assets on the lands adjoining the lines. This combination reassured investors that they could recuperate valuable assets in the case of insufficient revenues from the traffic between two connected cities (Fogel 1964, Landes 1969). An equivalent to this device for triggering the low-carbon transition would be for governments to provide a *public statutory guarantee on a new asset, which allows the central bank to provide new credit lines refundable with certified reductions of*

5 For the implications of a 'shareholder value regime' and a 'managerial business regime' on growth, see Hallegatte et al. (2008).

6 The legend satirises Buridan, a theologian at the Sorbonne, who recommended postponing action until having received full information about the context. In this legend, the donkey dies of hunger and thirst because it hesitated too long in making a decision between eating hay or drinking water.

7 The rationale for this device is described in Hourcade et al. (2012), and a version centred on the European context is developed in Aglietta et al. (2015).

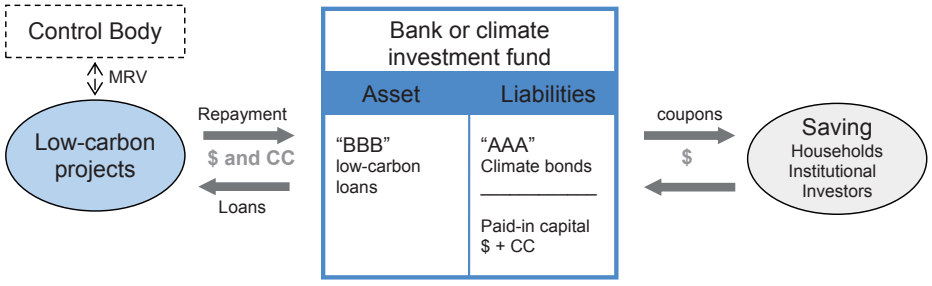
CO_2 emissions. The targeted credit facility would make possible bigger loans to low-carbon investments by lowering the financial risk. The facility could be operationalised through four steps.

1. *The international community recognises that climate remediation activities generate 'something of value'*. This value of Climate Remediation Activities (VCRAs) could be expressed through a notional price per tonne of avoided CO_2 emissions to be incorporated in new investments. It would comprise both the costs of meeting the 2°C target and the various co-benefits of mitigation activities (air pollution, benefits from recycling the revenues of carbon pricing, energy security). Controversies around the social cost of carbon (SSC) have cast doubts over the possibility of agreeing on such a value. But there are three differences between the concepts of the SSC and the VCRA. First, the VCRA would not be used to weigh climate change damages over the long run against the costs of mitigation; it would be estimated for a given target, and disputes about the discount rate would matter less. Second, countries might agree to the same VCRA for different reasons based on their own perceptions of the domestic co-benefits of climate mitigation within, for example, the estimated space of carbon prices given by the IPCC (US$55 to $140 per tonne of CO_2 in 2030 for a 450 ppm scenario) (Clarke et al. 2015). Third, contrary to a real carbon price, a VCRA would not directly hurt existing capital stock, would have less direct distributive impacts, and would therefore be at less risk of being blocked by a coalition of vested interests.
2. *Governments commit, on a voluntary basis, to backing (up to a predetermined quantity) carbon certificates (CCs)* to be allocated to low-carbon projects and priced at the VCRA. This allocation of CCs would lower the danger line stifling the capital-intensive low-carbon projects since, for example, a $100 loan would be reimbursed $50 in cash and $50 in carbon certificates. This would require an effective system of MRV along the lines described by Wiener in his chapter in this book, and monitoring by an independent body under the UNFCCC that would set the rules for the attribution of CCs per type of project in each country.
3. *Building on the governments guarantee, CCs are accepted* by financial intermediaries as *repayment for part of low-carbon loans,* because CCs can be either converted into climate remediation assets eligible for quantitative easing programmes launched by

central banks, or can be used as a guarantee for refinancing by the central banks of low-carbon loans up to their carbon value. Ultimately, after effective carbon emission reductions have been verified, the carbon certificates would be converted into Climate Remediation Assets that enter on the central bank's balance sheets (see Box 1).

4. *Banks or specialised climate funds* use the carbon-based monetary facility *to back highly rated climate-friendly financial products*, such as 'AAA' climate bonds, to attract long-term saving. This could be done by turning BBB portfolios of projects into AAA climate bonds via the public guarantee to CCs and the various pooling methods. Provided they have confidence in the declared value of CRAs, institutional investors might be interested in safe and sustainable bonds instead of speculative financial products for both ethical and regulatory purposes. This mechanism (illustrated in Figure 2) is critical for the redirection of private savings, without which the low-carbon transition will not trigger the virtuous economic circle developed in the next section. An important point for the political economy of the climate negotiations is that part of the CCs could be used to scale up the Green Climate Fund in order to secure multilateral cooperation and to avoid the Nationally Appropriate Mitigation Actions (NAMAs) being funded only by bilateral overseas assistance and the possible 'greenwashing' of this assistance.

Figure 2 Carbon certificates and the redirection of long-term saving towards low-carbon investments



This mechanism ultimately comes down to the issuing of money backed by a public guarantee and, akin to the case of US railways, backed by the real wealth of low-carbon infrastructures as collateral. It would rely on two major pillars in addition to the MRV process.

The first pillar is the value of CRAs, so far neglected in a literature that has focused on the financial channels and the evolution of prudential rules to improve the financial intermediation system. VCRAs play a critical role for four reasons. First, as it has the same efficiency effect as a carbon price, a VCRA hedges against the cost of fragmentation and political arbitrariness of low-carbon initiatives and carbon finance innovation. In this respect, it can constitute a lever for the deployment of climate finance devices, as described by Buchner and Wilkinson in their chapter in this book. Second, it helps countries make their INDCs economically consistent, since the loans will incorporate the same implicit carbon value. Third, because it is the discounted value of the flow of social values – which increases over time – it offsets the penalty imposed by discount rates on long-lived investments. Fourth, it hedges against the risk of lax monetary creation and of 'carbon bubbles', because the CCs have a nominal face value from which speculators on secondary bond markets cannot depart too much.

The second pillar is the quantitative commitments made by governments. Political realism suggests that this kind of system can be launched only by a 'club of the willing'. Contrary to what Nordhaus (2015) envisages for carbon pricing clubs, the incentive to join the club and to observe its rules would not be provided by penalties but by automatically depriving defaulting countries of access to the credit facilities opened by the system. Such a system needs agreed-upon rules on governments' commitments to back a given amount of carbon savings investments backed by governments, which go beyond the scope of this chapter. One key principle, developed in Hourcade and Shukla (2015), would be to organise rules such that they act as pull-back forces inciting countries to narrow the distance between their emissions and a normative trajectory. What matters is that these rules would not play the same role as in the case of the Kyoto Protocol;[8] there would be no immediate consequence for domestic energy prices and the amount of international transfers would be controlled ex ante (only a share of the credit lines opened thanks to governmental backing).

8 Unlike the very successful Montreal Protocol on reducing ozone-depleting substances that included trade restrictions between parties and non-parties, Article 18 of the Kyoto Protocol prohibited the use of a compliance mechanism that would entail "binding consequences" unless adopted by amendment of the Treaty. As under the GATT, under the Kyoto Protocol a sanction against a party had to be approved by the party it was aimed at! (Mathys and Melo 2011). The reasons for this outcome are explained in Hourcade and Ghersi (2002).

Box 1 The creation of CRAs and the circuit of balance sheets

Table 1 shows how a central bank's balance sheet is transformed by the creation of a CRA starting from a \$1,000 loan to a low-carbon entrepreneur expected to realise 10 units of CO_2 emissions reduction and a VCRA set at 10/tCO_2. The loan is divided into two credit lines (Table 1): \$900 lent at rate r_l and financed by deposits remunerated at rate r_d, and \$100 equivalent lent by the central bank to a commercial bank that can be paid back with certified carbon certificates (CCs). Prudential rules about minimum capital requirement only apply to the first credit line (900 r_l) as a zero coefficient risk is applied to the second credit line backed by a government guarantee. The net worth increase of the commercial or development bank is only 0.08*900r_l instead of 0.08*1000r_l in the BAU case (i.e. conventional funding of the project).

The CB now owns a new \$100 claim on the commercial bank. Thanks to the \$1,000 loan, the entrepreneur launches the low-carbon project (LCP) with an expected return of R^{LC}, giving total expected revenues of \$1,000 R^{LC}. Under the assumption that the project realises the 5 units of expected emission reductions, two lines appear on the liability side of the entrepreneur's balance sheet: \$900 paid back with the monetary revenues of the project at the interest rate r_l, and \$100 paid back with carbon certificates.

Table 1 Balance sheets at time of opening the low-carbon loan

Central bank		Commercial bank		Entrepreneur	
Asset	Liability	Asset	Liability	Asset	Liability
				100 R^{LC}	
Loan CO_2		+900r^l	+900r^d		+900r^l
+100	+100	+100	+100		+100
			+0.08(900r^l)		

10 CO_2	100
Reduction of CO_2	Drawing rights

As the project realises emission reductions, the entrepreneur receives CCs. At the loan maturity (Table 2), the entrepreneur has reimbursed the entire $900 debt with the project revenues and has received 10 CCs for the project's emissions reductions. The first credit line of the balance sheet of the commercial bank becomes null and only the second credit line remains.

Table 2 Balance sheets at the end of the payback period of the low-carbon loan before the asset swap

Central bank		Commercial banks		Entrepreneur	
Asset	Liability	Asset	Liability	Asset	Liability
				1000 R^{LC}	
Loan CO_2		+0	+0	-900r^l	+0
+100	+100	+100	+100	+10 CC	+100
			+0		

10 CO_2	100
Reduction of CO_2	Drawing rights

Then the central bank performs an asset swap, as it accepts the 10 CC as repayment of its $100 financial claims and the second credit line corresponding to the 'carbon debt' of the low-carbon project can be cancelled out (Table 3). The total amount of carbon-based liquidities that the central bank can still issue is reduced by 100.

Table 3 Balance sheets after the carbon asset swap

Central bank		Commercial banks		Entrepreneur	
Asset	Liability	Asset	Liability	Asset	Liability
10 CC				1000 R^{LC}	
~~Loan CO_2~~		+0	+0	-900r^l	+0
~~+100~~	+100	~~+100~~	~~+100~~	~~+10 CC~~	~~+100~~
			+0		

~~10 CO_2~~	~~100~~
Reduction of CO_2	Drawing rights

Other circuits are possible. Commercial banks with a high share of low-carbon projects in their loan book would have a less risky balance sheet, as it would benefit from a public guarantee. They could keep part of the carbon assets. Banks would then be rewarded with a reduction of the cost of their prudential capital constraint by applying a zero risk coefficient – in the same fashion as with sovereign bonds – to the fraction of the loan that comes from central bank liquidities backed by the value of emission reductions. Firms could also keep the CRAs in their balance sheet to improve their value in terms of the Capital Asset Pricing Model.

4 Crowding out, or dragging the world out of the economic doldrums?

The primary aim of a CRA device is to trigger a wave of low-carbon investments that are currently blocked by their upfront cost in today's uncertain economic context, and many such investments exist.[9] Further, this device would facilitate the deployment of price-based mechanisms – the amount of financially viable low-carbon investments for a given carbon price would be higher and the existence of a VCRA and of a strong MRV process would make it easier to turn the product of mitigation activities into financial carbon assets. Governments will have a real incentive to implement carbon-pricing policies to generate more carbon assets, which will balance the public budget.

The fact that these devices are good for climate mitigation does not imply that they are good for the economy in general. The strong arguments in favour of the 'green growth hypothesis' (OECD 2009, World Bank 2012) are often countered by the 'crowding out' argument (Popp 2012), i.e. that to bias investments in favour of low-carbon projects would crowd out other investments that could be socially and economically beneficial and would thus generate no positive impact on economic growth.

This argument has to be revisited in the current adverse world economic context of a gap between potential growth and real growth. One of the sources of this gap is the

9 One good analysis of the orders of magnitude of this leverage can be found in De Gouvello and Zelenco (2010) in their hypothesis of a low-carbon development facility.

saving glut, diagnosed by Ben Bernanke in 2005, due to a high propensity to save and a low propensity to invest. This leads to difficulties in maintaining sufficient demand to sustain normal levels of output, and explains the warnings about the 'depression economics' (Krugman 2009) and secular stagnation (Summers 2014). The CRAs could help prevent this via the creation of intermediaries that are able to bridge long-term assets and short-term cash balances so that savings are invested productively without incurring the risks of excessive leverage, maturity mismatch (illiquid long-term assets financed by short-term assets) and interconnectedness (unsecured liabilities of money market funds), which fostered the systemic crisis.[10]

Illustrative simulations suggest that, over the short run, the CRAs would boost investments and final demand by backing credit facilities with equipment and infrastructures as collateral. Their macroeconomic impact could be important because they imply incremental investment efforts (around 0.5% of GDP over the forthcoming decades) with a high ripple effect because the level of redirected investments is around 8-9% of the gross capital formation.[11] This redirection would entail inevitable tradeoffs and choices, but would not mean sacrificing social priorities. It would bring the economy closer to its potential growth by reducing the saving glut and satisfices the social aims through low-carbon techniques. Over the long run, it would translate into reality Schumpeter's message that long-lasting innovation waves can take off only when their promise is supported by the 'animal spirits of finance'. Instead of generating long-term investment shortfalls and repeated speculative bubbles, these animal spirits would trigger a wave of 'green' innovation (Stern 2010, Stern and Rydge 2012) that is necessary to sustain a long growth cycle, much as oil, automobiles and mass production did in the previous century.

A low-carbon transition supported by the CRA device could thus have a macroeconomic value that should be of interest to climate-agnostic policymakers. In addition to reducing the gap between the propensity to save and the propensity to invest, it would also help

10 Multilateral finance institutions (the ADB, the World Bank, the EBRD, and the EIB) invest in principle on long-run horizons. But the scope of their interventions remains limited and they are not suitable for driving savings towards the multiplicity of scales of investments that are needed, including small-scale ones. Insurance companies work on reducing risks of long-term investments, but do not invest in these themselves. On the limits of the current financial institutions, see UNEP- (2015), Canfin-Grandjean Commission (2015) and OECD (2015).

11 Simulations carried out on the basis of the of the International Energy Agency's *World Energy Outlook* (IEA 2014) and published in Hourcade et al. (2014).

to address one of the major 'fault lines' of the world economy as pointed out by Rajan R.G. (2010), that is, the development strategy of developing countries. This strategy is currently based on export-led growth, which is implies excessive dependence on the ability of foreign consumers to pay. It constrains domestic demand and to leads to under-valuations of currencies.

Governments are hesitant to alter this strategy because of the uncertainty over recovering jobs lost in the export-led sectors through the domestic-oriented production sectors, and the risk of excess protection in domestic-oriented production sectors resulting in inefficient projects. A CRA device would facilitate this strategic change. In addition to generating important North-South flows in support of INDCs directed towards domestic markets and activities, it would address the IMF's warning about the lack of infrastructure investments (IMF 2014) and, given the sectors concerned (energy access, buildings, transportation), would contribute to inclusive development (World Bank 2012). It would also decrease the need for a 'war chest' of official reserves in foreign currencies, since the CRAs would become a de facto common numeraire for interbank settlement payments.

5 Conclusions

I have argued that harnessing the animal spirits of finance to enable a low-carbon transition is necessary for launching ambitious climate policies and would help bring the world economy out of the current context of economic uncertainty. The proposed Climate Remediation Assets (CRAs) are a way to achieve the required ambitious climate policies. CRAs would be instrumental in implementing the "*paradigm shift"* adopted in Cancun *"towards building a low-carbon society that offers substantial opportunities and ensures continued high growth and sustainable development"* and *"equitable access to sustainable development" (UNFCCC 2011).* The underlying intuition is that the required climate policies question the implicit social contract at the national and international levels that relies on cheap energy and cheap fossil fuels, which has led both households and enterprises to adopt behaviours based on capital stock (mobility, housing modes, location of human settlements) that cannot be altered overnight.

Finance is, with fiscal systems, a key component of any new social contract. Monetary-based finance would in effect be saying: *"My government really thinks that avoiding carbon emissions is something of value. By adopting CRAs it is giving clear and immediately tangible support to investment initiatives in low-carbon projects and technologies, and in doing so it is proving its commitment to combatting global warming and to a more sustainable development, and helps me to take part".*

This is a form of forward contract that has to be passed within each country, but will realise its potential only if it quickly involves most of the international community. This is possible because a fully-fledged CRA system would not require adversarial negotiations over the division of the remaining global CO_2 emissions budget (Averchenkova et al. (2014). It needs an agreement on the economic and social value of mitigation activities and on rules to coordinate the amount of CRAs that governments commit to backing. These rules will be a way of translating the CBDR principle between countries – with different historical responsibilities for both climate change and the current drawbacks of the financial system – in the context of a cooperative process.

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