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Quantity-Performance Instruments for Public Climate Funds

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Mobilizing the Private Sector

Quantity-Performance Instruments for Public Climate Funds[a]

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1. Introduction and Background

In recent years, public sector funding, in general, and for the support of activities in developing countries, in particular, has become more and more 'results' and 'performance' oriented. The Governing Instrument of the recently established Green Climate Fund (GCF),[1] for example, tasks the GCF Board with establishing 'a framework for the monitoring and evaluation of performance … of activities supported by the Fund' and approving a 'results measurement framework with guidelines and appropriate performance indicators'.

There are different methods by which performance can be 'indicated' (or even 'measured') in this context. The World Bank, for example, uses *Country Performance Ratings* which are based on its Country Policy and Institutional Assessment (CPIA) and country implementation performance indices based on its Annual Report on Portfolio Performance. In the CPIA, countries are assessed with respect to 16 different criteria in terms of a largely qualitative 6-level ranking.[2] The focus of this brief, however, is on activities that are associated with *quantitative performance* indicators, i.e. performance assessed in terms of measured quantities − such as tonnes (of carbon), kWh, or hectares − as carried out by the private sector.

The aim of this brief is to review options for the use of such Quantity-Performance (QP) instruments as a way of channelling public funds to mitigate greenhouse gas emissions in a cost-effective way. QP instruments reward quantified mitigation performance, typically measured in tonnes of CO_2-equivalent of achieved emissions reductions.[3] As such, they imply exactly the kind of results monitoring that the current trend in public funding demands. They could be used by governments or multilateral funds, such as the Green Climate Fund, to mobilize the private sector and private sector finance for mitigation activities in developing countries.[4]

QP instruments could provide a valuable complement to other well-known funding instruments for private sector mitigation activities in developing countries, such as *ex ante* public sector funding of projects and programmes, as well as *ex post* policy-driven market mechanisms, such as the Clean Development Mechanism (CDM). QP instruments are, as it were, a mixture of these two alternatives, combining the use of public funding with *ex post* payments for emissions reductions.[5]

Like traditional *ex ante* funding modalities, QP instruments are based on public sector finance, which is not the case for market mechanisms such as the CDM. Accordingly, the capacity of these QP

[1] Annexed to UNFCCC Decision 3/CP.17 (http://unfccc.int/resource/docs/2011/cop17/eng/09a01.pdf#page=2)
[2] For a review of these indicators, see Müller (forthcoming).
[3] Such instruments can also be applied to kilowatt-hours of renewable generation or other outcomes where each quantified unit is equivalent to one another in terms of environment or social benefit.
[4] This focus on mobilizing private sector finance is not meant to minimize the use of public funds for other uses such as in supporting (sectoral) NAMAs or allocating resources to National Funding Entities. Performance-based financing may well have a role in those areas as well. Norway has recently submitted that 'Result-based financing, in the form of payments for verified emissions reductions at the sector- level relative to a baseline, has the potential to incentivize governments to create an improved environment for commercial investments and needs to be explored'(Norway 2012). Müller, Fankhauser, and Forstater (forthcoming) will be discussing the use of QP instruments in resource allocation methodologies.
[5] There have been parallel developments in healthcare, with initiatives broadly categorized under 'Payment by Results'. The World Bank's portal on results-based financing for health (www.rbfhealth.org/rbfhealth/) offers a range of case studies. Broadly, PBR approaches could include cash-on-delivery aid, output-based aid, and prizes. Of these, output-based aid would be similar to QP instruments, as the financing flows from the donor (or the public sector fund) to the service provider (or the vendor reducing emissions). Payments are made only when the health service is delivered or emissions are reduced.

instruments will depend on the predictability and adequacy of the relevant public sources.[6] At the same time, QP instruments may well motivate contributors to increase their levels of commitment, knowing that funds will be spent only for delivered reductions. Also, by providing transparent accounting for mitigation investments, project investors might realize further benefits from a positive environmental association.

Like the CDM, QP instruments involve *ex post* rule-based 'payments for performance'. Compared with traditional *ex ante* public sector funding, this can be seen as a devolution of decision-making to the relevant private sector entities, with clearer incentives to deliver emissions reductions but also a concomitant performance risk transfer.[7] It is possible to use allocation mechanisms (such as auctioning) that make QP instruments, in principle, more cost-effective than *ex ante* alternatives.

Conceptually, one could imagine QP instruments with or without *ex ante* contracting. That is, they could involve *ex post* purchasing of achieved reductions with or without a vendor being assured of the sale *ex ante*. We focus on the case of *ex ante* contracting because it is clearer to us, at this time, whether and how such instruments will create incentives for mitigation activities.[8]

As the CDM has shown, cost-effectiveness may not achieve certain distributional goals:[9] The financial flows generated have been famously 'geographically imbalanced', with the top four host countries generating more than nine-tenths of all credits.[10] It could be argued that this imbalance is not 'unfair' because the over-arching purpose of the CDM is to deliver emissions reductions to the market at the lowest price. However, such a singular purpose is unlikely to succeed in the case of public-sector funded QP instruments, particularly if the funds in question are seen as shared resources for all developing countries.

In order to avoid a conflict between fairness and cost-effectiveness, public sector QP instruments may well have to involve some form of *ex ante* allocation ensuring a geographic and/or sectoral balance among potential recipients *prior* to applying the QP instruments within each region and/or sector. We will revisit this issue in Section 5. First, we will focus on QP instruments themselves and describe their common characteristics, before looking at various forms of QP-based funding tools, and then evaluating their relative merits.

[6] Generally, we would expect contributions to occur *before* QP contracts are written. However, if there were uncertainties in the funds available to pay for emissions reduction activities, especially if payouts were expected to occur over several years, this could dissuade vendors from committing to invest in the activities.

[7] Traditionally, but not exclusively, *ex ante* project funding is tied to the project cost and not the project yield in term of emissions reduced. The performance risk – that the project will deliver the promised emissions reductions – is with the public funder, which is why a project proposal evaluation is crucial to minimize that risk. Yet, once funded, the incentive to deliver is dramatically reduced. By paying for delivery, there is less need for project evaluation, as project hosts have the incentives to deliver emissions reductions.

[8] Without such *ex ante* contracting, vendors must invest in mitigation activities without any guarantees. Without any guarantees, the incentive for mitigation is less clear.

[9] Cost-effectiveness may also not be aligned with other, non-distributional goals. In particular, countries may be concerned about non-climate-related social and environmental impacts of mitigation projects. After such impacts are identified, it is relatively straightforward to adjust the QP instrument to address them.

[10] 'Certified Emissions Reductions issued by host countries', 893m, as at 23 March 2012: China (60%); India (15%); South Korea (9%); Brazil (7%).
See http://cdm.unfccc.int/Statistics/Issuance/CERsIssuedByHostPartyPieChart.html

2. QP instruments defined and commonalities

Quantity-Performance instruments come in various guises, but they all share a common characteristic: they provide *ex post* financial support based on verified emissions reductions. As such, they have the potential for cost-effective allocations of public funds, providing incentives for eligible recipients of public sector funds to supply as much (quantity) verified reduction as possible.

Like the CDM, and other crediting mechanisms from deforestation pilot projects to voluntary crediting systems, QP instruments presuppose that emissions reductions (or other quantifiable outcomes) are well-defined and measurable − that there are agreed-upon and generally accepted measurement, reporting, and verification methodologies. This means that QP instruments are only applicable to mitigation activities where such measurement is possible. In these cases, implementation may be accelerated by borrowing methodologies from existing programmes such as the CDM. Other types of public funding instruments would be required for other mitigation activities. In some cases, public investment in capacity building and institutional development could remove barriers where QP-based instruments are not (currently) feasible.

Moreover, certain reductions may be excluded even if the quantity is verified. QP instruments may contain supplemental eligibility criteria. These could be geographical (such as only considering reductions from LDCs), thematic (for example no nuclear, large-scale hydro, etc.) or socio-economic (such as being additional, or having certain sustainable development co-benefits).

Certification of reductions – in other words, the verification of the amount reduced and the assessment of whether these supplemental criteria are fulfilled – can be designed at different levels of thoroughness. A thorough certification will typically require considerable time and effort and may create uncertainty for project developers about the eventual outcome. Alternatively, certification can be designed for speed, processing as many projects as possible with less attention to outcomes and supplemental eligibility criteria. While in some cases the outcomes and eligibility are unambiguous and can be evaluated quickly, many, if not most, cases involve such a trade-off. The decision of how to balance the desire for both speed and accurate evaluation will be one of the key decisions in the design of a QP instrument, particularly with the goal of attracting the private sector while simultaneously safeguarding public funds.[11]

The use of contracted *ex post* payments for verified emissions reductions places a financial incentive squarely on the emission outcome. But that is only half the recipe for cost-effectiveness. The other half is a competitive allocation process, typically some kind of auction. This type of competition encourages vendors to reveal the emissions reductions they are willing to supply at different prices. Funders then sort vendors to maximize tonnes of emissions reduced, given a limited budget.

Technically, such a system is often arranged as a 'procurement' or 'reverse' auction, where sellers bid rather than buyers. That is, mitigation vendors write out bids that stipulate the emissions reductions they are willing to provide at a particular price, and submit them to the funders without telling other vendors. Vendor projects must meet the appropriate eligibility criteria, which should be designed to

[11] In cases such as restrictions of geographical origin, the certification effort required may be negligible. In the case of socio-economic conditions, this may not be the case, although in the case of additionality, it may be possible to incorporate the basis for evaluation in the very base line used for quantity verification (see Müller 2009). But generally this will not be possible.

ensure that there is the capability, technology, and experience to deliver the promised emissions reductions. Vendors who offer to sell reductions at lower prices will win the reverse auction.[12]

Alternatively, funders can write contracts to buy reductions at a *fixed* price and then sell those contracts to vendors through a normal auction. Assuming reductions are profitable at the fixed price offered by the funders, vendors will bid to buy the contracts. In the auction, vendors write out bids specifying how much they will pay for such contracts and submit them to the funders (again, without telling other vendors). Vendors who offer to pay more for the contracts will win this regular auction. Both systems lead vendors to compete with each other for limited public funds and create incentives for cost-effectiveness so as to maximize verifiable mitigation.[13]

An auction (of either type) need not be the only step in the allocation process. It is possible to narrow down and focus the scope of auctioned QP instruments by imposing eligibility constraints on the emissions reductions – in other words, only considering reductions from certain sources (countries, project types, etc.) – without jeopardizing the cost-effectiveness within that given scope. After defining the scope, the funder is no longer involved in decisions about specific projects. In this way, an auctioned QP instrument creates an automatic and transparent funding mechanism once the scope and eligibility are established and the public funds have been secured: there is no further approval of strategies, plans or project proposals by the funder, enabling vendors the utmost freedom in how to supply eligible emissions reductions.[14]

While auctions do not need to be used with QP instruments, other, non-competitive, allocations of QP instruments are unlikely to be as cost-effective or as transparent. Given a collection of mitigation vendors, where each is willing to undertake quantifiable mitigation activities in exchange for some funding, how could one decide who to fund if not through an auction?

Funding could be provided on a first-come, first-served basis until the resources are expended (this is sometimes referred to as a 'derby'), as implemented in the Clean Technology Fund and proposed for the Prototype Methane Financing Facility (PMFF).[15] In case of the PMFF, existing valuation criteria – in particular, CDM – would have played a large role in selecting projects, especially in the early stages. Even there, however, applications would largely have been reviewed and approved on a first-come, first-served basis. Besides first-come, first-served, one could, for example, also hold a lottery among eligible projects to rank them, and then fund them in the order determined by the lottery until the resources are expended.

Both of these approaches would be transparent, but not cost-effective, as less expensive opportunities could be left unfulfilled. One could ask mitigation vendors to apply for funding; funders could then review the applications and choose who to fund (*ex post*). If the only criterion is cost, this would be

[12] As noted earlier, the reverse auctions could be either for direct emissions reductions or for kilowatt-hours of clean energy, with the emissions reductions counted implicitly.

[13] That is, assuming no collusion or other anti-competitive behaviours, the format would maximize verified emissions reductions relative to other forms of fund disbursement. The auction format could even go a step further and be designed to elicit truthful revelation of underlying costs by private sector entities and project developers (Montero 2008).

[14] This is a significant benefit in terms of administrative cost to funders. A QP approach outsources project certification to bodies like the CDM EB and outsources project selection to the private sector. This means a large quantity of public finance can be managed by a small team. Of course, should the number of projects increase significantly, the CDM EB will also need commensurate capacity to verify emissions reductions and certify projects.

[15] Methane Blue Ribbon Panel (2009).

equivalent to an auction; if other criteria are used, it would not be cost-effective. In any case, it would probably be less transparent for vendors.

In considering possible vendors, one may have in mind (private sector) project developers or sovereign countries, for example through National Climate Change Trust Funds (National Funding Entities). One could also imagine national entities themselves utilizing QP instruments rather than international funds. That is, having received funds through a resource allocation process,[16] national entities would then use QP instruments to mobilize the (domestic) private sector for reducing domestic emissions. Such an approach could have the advantage of allowing a more direct alignment of national objectives and QP funding (although this could also be accomplished through certification criteria or domestic policy choices).

Emission markets may or may not play a role in QP instruments, depending on the QP design and whether markets do, in fact, emerge. QP instruments can be designed so that public sector funds become the catalyst for reductions ultimately delivered into a market, if and when an emission market is ready. In that case, QP instruments can contribute to substantial reductions in risk to vendors, associated with unexpectedly low carbon prices.[17]

Alternatively, QP instruments can be designed to buy verified reductions without regard to the existence of an emission market. While the catalyst approach would allow QP instruments to leverage more verified reductions as targeted by the instruments' defined scope, the non-market approach would keep mitigation supported by emission markets separate from activities incentivized by public funds. The important point is that QP instruments can be used to distribute public funds cost-effectively in the context of achieving verified emissions reductions within a defined scope of eligibility, whatever one's views about markets might be.

Regardless of their relation to an offset market, QP instruments shift much of the performance risk for delivering certifiable reductions from funders to vendors, when compared to traditional *ex ante* public funding mechanisms. Traditional funding mechanisms require a careful and time-consuming initial vetting process before distributing funds, and then depend on the project developers to deliver their promised emissions reductions. If they do not perform, the public funders lose. In this way, funders hold much of the performance risk.

By contrast, QP instruments forego much of the initial vetting but do not pay out unless the (certified) reductions are delivered. In this way, most of the performance risk is shifted from the funder to the vendor. Making payment contingent on delivery creates added incentives for vendors to succeed.

Even with QP instruments, when a vendor fails to deliver on contracted reductions, public funds are tied up in anticipation of delivery. This can frustrate both funders and other vendors.[18] Different QP variations can address this type of non-performance differently. We will revisit this question at the end of Section 4.

[16] As will be argued in Müller, Fankhauser, and Forstater (forthcoming), (multilateral) resource allocation to National Funding Entities could itself involve QP-instruments.

[17] Note that in this case, the public funding subsidized what turned out to be more expensive developing country mitigation options than the market ultimately delivered. Public funding will never match private sector funding, be large enough to impact the market price, or affect the cost to developed country buyers.

[18] This phenomenon has been documented in a variety of reverse auctions of direct purchase instruments for renewable power (Wiser 2002; Council on Energy, Environment and Water, and Natural Resources Defense Council 2012; see Box 1).

3. QP Variations

Proposals for various QP-based funding instruments range widely in their design – frequently in the way in which they expect to interact with a prospective carbon market. Three have featured prominently in climate finance debates thus far, and each itself having a number of variants (though all with the defining feature of QPs generally – their potential to deliver cost-effective emissions reductions within a defined scope).

A. Direct purchase

The simplest QP instruments are based on the direct purchase of verified reductions by the funder. That is, the funder would offer to buy reductions at a specified price with a given pool of public funds. Determining who gets to sell the reductions at what price is the question of allocation. One cost-effective way to allocate – that is, to achieve the most reductions with the given pool of public funds – is a 'procurement' or 'reverse' auction. The funder would solicit bids from vendors who specify the amount they are willing to supply at what price. The funder then chooses the bids with the lowest prices as the winning bids (Edwards 2010). Funders might be National Funding Entities or the Green Climate Fund; vendors could be private sector project developers.[19]

Much work has been done on the exact details of designing such auctions – such as how bidding is conducted and how much the winning bids are paid.[20] Additionally, the terms of the auction must also be considered, including eligibility, when the emissions reductions associated with winning bids must be delivered, and any penalties or consequences for failure to deliver the emissions reductions from a winning bid (referred to as 'non-performance'). Reverse auctions have been used to select project developers under India's National Solar Mission and have been responsible for a sharp decline in the per unit cost of solar power (see Box 1).

Other allocations are possible, though most will not encourage cost-effectiveness. For example, reductions could be bought through discretionary 'purchases', where the funder chooses a group of vendors to fund and agrees to pay them a certain price per unit of eligible reductions (with an upper quantity limit). By choosing a limited number of vendors and an upper quantity limit, funders are assured they will have enough funds. However, since the vendors and the price are not chosen through an open and transparent competition, it is difficult to achieve a cost-effective outcome.

Direct purchase instruments do not presuppose the existence of carbon markets, simply the existence of an agreed system to measure reductions or other units of action (such as kilowatt-hours of renewable power generation). If reductions take place in the context of a carbon market, where such emissions reductions are potential credits valid for compliance purposes, purchased reductions could be cancelled or retired, or eventually resold into the market.[21] Both approaches would provide an immediate catalyst for emissions reduction projects; retirement would improve the environmental outcome, while resale would make scarce public funds available for other purposes.

[19] One variation on this instrument is the direct purchase mechanism that underlies the Amazon Fund (Zadek, Forstater, and Polacow, 2010). In that programme, donors have agreed to pay the *host country* for reduced emission from deforestation below an agreed baseline over a specified horizon.
[20] For examples, see Ausubel (2002) and Milgrom (2004).
[21] Müller and Ghosh (2008). Cancelled or retired credits will not enter a carbon market for compliance purposes.

Box 1: India's National Solar Mission – applying reverse auctions to discover prices and level the playing field

The Indian government launched the Jawaharlal Nehru National Solar Mission in January 2010 to galvanize a nascent solar market with the aim of deploying 20 GW of grid-connected and 2 GW of off-grid solar power by 2022. One of the key features of the Mission is the use of reverse auctions to select technically qualified projects at the lowest per unit cost of solar electricity. Reverse auctions have two main benefits. They allow government procurers to select projects based on lowest cost (thereby keeping the burden on fiscal resources and taxpayers low) and they ensure that a price-based selection process would be transparent and fair.

So far, two rounds of bidding have taken place for a total of 1000 MW of grid-connected capacity. For the first round of bidding, the government set the maximum reverse auction price at Rs.17.91/kWh ($0.45/kWh) but the lowest bid price dropped to Rs.12/kWh ($0.32/kWh). During the second round, the reverse auction was even more aggressive, with the lowest winning bid at Rs.7.49/kWh ($0.15/kWh) for a 5 MW plant, a 51 per cent discount on the maximum reverse auction price for the second round.

Projects selected based on lowest-priced bids are offered feed-in tariffs and long-term power purchase agreements (PPAs) until the available MW capacity designated for each batch of bidding has been allocated. The feed-in tariffs to developers are further complemented by support to power utilities by bundling solar power with conventionally produced electricity, which reduces the average per unit cost of solar power. An intermediary (the NTPC Vidyut Vyapar Nigam, or NVVN) has been authorized in Phase 1 of the Solar Mission to bundle 1000 MW of grid-connected solar power with four times as much power from thermal power stations owned by NTPC (the National Thermal Power Corporation). Each unit of bundled power comprises one unit of solar power and four units of thermal power (which is much cheaper). The average cost of bundled power that the electricity utilities purchase from NVVN is, consequently, much lower than purchasing an individual unit of solar power directly from a solar project developer.

In the first phase of the Mission (2010–12), the government deliberately kept the project sizes small (5 MW for the first round of bidding and 20 MW for the second) in order to open the market to a broad range of companies rather than lock in a few firms as dominant players at an early stage of the industry. Five MW was the limit per project *and* bidder for the first round of bidding; 20 MW was the limit per project and 50 MW per bidder for the second round (these limits were for solar PV projects).

But one potential danger is that of overly aggressive bidding by inexperienced developers. If prices are driven too low and projects become financially unviable, then confidence in the Mission as a whole could become compromised. This risk has meant that reverse auctions have to be supported by thorough due diligence, along with larger deposits and penalties for non-performance (either timeliness of projects or amount of electricity generation). Project bidders are required to submit a bank guarantee (Rs.3 million per MW) at the time of signing the PPA, along with a 'bid bond' applicable per paise (100 paise = 1 rupee) of the discount that the bidder offers on the tariff approved by the regulator. If the project developer does not execute the project within the stipulated time period, the bank guarantees relating to the bid bond are encashed.

Despite the cap on the MW allocation per project and bidder, cases have emerged where a few EPC (engineering, procurement, construction) contractors have secured contracts for executing projects that add up to much more than 5 MW. There have been accusations that large EPC contractors created front companies to bid for projects in order to corner a larger share of the market.

Thorough due diligence and strict enforcement of performance benchmarks can ensure that inexperienced developers do not crowd out more expensive but viable projects, and that large companies are unable to use smaller players as a front to capture a large share of the market.

Source: Council on Energy, Environment and Water; and Natural Resources Defense Council (2012).

B. Top-up instrument

If the funder is going to resell credits from a direct purchase mechanism into a compliance market, the cost to the funder becomes the difference between the direct purchase price and the compliance market price. That is, they pay out the direct purchase price but then receive back the market price when they sell the credit into the market.

Rather than the funder purchasing credits and reselling them, the vendor and funder can achieve the same outcome using top-up instruments. Top-up instruments oblige the funder to pay the vendor the difference between an agreed price and the prevailing carbon market price when the credits are delivered to market. This serves to 'top up' the revenue generated through the sale of reductions as credits/offsets into an existing market. If the prevailing market price *exceeds* the agreed-upon price when the vendor is ready to deliver the emissions reductions, the funder pays nothing, the funder's obligation to the vendor ends, and the credits are simply delivered to market, as seen in design documents for the PMFF.

Like the direct purchase agreement, top-up instruments can be allocated to potential vendors in a variety of ways. A reverse auction along the lines discussed for the direct purchase agreement can provide a cost-effective allocation. Or, the instruments can be distributed through some type of discretionary application and approval process. As with direct purchases, when criteria other than cost enter the decision, such a process is unlikely to deliver a transparent and cost-effective outcome (and if cost is the only criterion, it would be analogous to an auction).

Unlike the direct purchase agreement, however, where there may or may not be a relationship to a specific carbon market, top-up instruments explicitly tie themselves to a market. The top-up instrument both ensures that the contracted reductions eventually enter that market, and links the top-up payment to the price received by the vendor.[22]

C. Tradable put options

The previous two examples of QP instruments generally assume a straightforward process where (1) the funder conducts an allocation process, (2) those receiving a QP allocation undertake verified emissions reductions, and (3) payments are made based on delivery of those verified emissions reductions. For a variety of reasons, however, those receiving the QP allocation may be unable to fulfil the emissions reduction obligations they have promised. This raises the question: could such vendors (those in receipt of a QP allocation but unable to fulfil it) somehow transfer the allocation to another vendor to fulfil?

The idea of a tradable put option provides a straightforward way in which this can happen. Using this approach, the funder creates *tradable option contracts* for vendors. The contract provides the vendor with the right, but not the obligation, to sell (in other words, a 'put option') to the funder a certain amount of reductions at a certain agreed price ('strike price') by a certain time (Müller 2008, Pizer 2011). Importantly, these contracts can be bought and sold: if the current holder decides they are unlikely to use the contract, they can sell it to someone else who will use it.

How does this work? At the moment an option is executed – when emissions reductions are delivered and payment is made by the funder – the value of the option equals the difference between strike price

[22] Note that the top-up approach, where the funder's payment depends on the market price received by the vendor, raises issues about arm's-length transactions if an official market price does not exist. See, for example, Bernard and Weiner (1990).

and the market price for verified emissions reductions. That is because the vendor could simply sell their emissions reductions in the market and receive the market price. In fact, if the market price is higher than the strike price, the vendor *should* sell the emissions reductions into the market, and the option contract will have zero value at that point. Otherwise, the value of the option to the vendor – that is, what the vendor would be willing to pay for the option contract – is the *extra income* from selling to the funder at the strike price specified in the option contract rather than selling to the market.

If the option contract is executed and the funder buys the emissions reductions at the strike price, the put option looks like a direct purchase where the funder is actually acquiring the emissions reduction. Like a direct purchase, the funder then could retire the credit or sell it back into the market. However, like a top-up instrument, use of the instrument is linked to a market: if the market price is higher than the strike price, the vendor will sell the credits directly into the market, the contract will expire, and the funder will have no further obligation associated with that contract.[23]

Unlike both the direct purchase and top-up instruments, however, the put option contract is transferable.[24] Before the option is executed, even years before, the option still has value, but that value is related to expectations about the future credit price and its relation to the strike price in the put option contract. In the very early years, if a credit market and price has not emerged, the value of the put option will be the difference between the strike price and the cost of the emissions reductions. With enough people buying and selling these option contracts, a consensus about the value of these option contracts can also be determined by the market.

This leads to an important distinction for put options from both the direct purchase and top-up instruments: in a limited sense, the cost-effectiveness of put options does not depend on how they are allocated. That is, put options will always flow towards the least expensive mitigation options regardless of how they are initially allocated. Suppose a put option with a strike price of $10 per tonne of emissions produced is in the hands of vendor A whose costs of reducing emissions are $9 per tonne. If another vendor B comes along whose costs are only $7 per tonne, that vendor would be willing to pay up to $3 for that put option (the selling price minus her costs). Since the option is only worth $1 to vendor A (the option's selling price of $10 minus his costs of $9), there is room for a trade that makes both vendors better off.[25] In this way, put options should migrate into the hands of those who can reduce emissions most cheaply at any point in time.[26] While tradable put options will end up encouraging the lowest-cost reductions regardless of the allocation method, the cost to the funder will depend on the allocation method. In this sense, this general conclusion about the cost-effectiveness of put options is 'limited' until we decide on an allocation method. The maximum cost to the funder of a put option is the strike price (per tonne) specified in the contract (multiplied by the number of tonnes covered by the contract). However, these put options immediately have market

[23] It would be a bit unusual for funders to retire the credit if the option is executed and do nothing if it is not executed. If retirement is the goal, a more sensible approach would be to specify that the funders would purchase and retire market credits in the case where the option is not executed.

[24] There is no technical reason why direct purchase or top-up instruments could not be transferred. A tradable direct purchase instrument would look like a futures contract, while a tradable top-up instrument would be exactly the same as the put option.

[25] This trade assumes that vendor A has not yet made his $9 investment.

[26] As with all financial markets, and particularly a government-organized derivative market, it is important to ensure that outcomes are accomplished efficiently, fairly, and openly so as to reflect the forces of supply and demand. Concerns about price discovery, market transparency, optimal participation, and prevention of manipulation, fraud, and other abuses need to be addressed through adequate and appropriate market oversight. See, for example, Interagency (2011).

value because they can be resold. So, one allocation option is for the funder to sell these contracts. This revenue can then be used to finance more put options (or other activities), increasing cost-effectiveness. If put options are sold through an auction, this will maximize cost-effectiveness.

If the funder gives away these put options, or otherwise sells them at less than their market value, the recipients can (and, based on profit motives, should) re-sell the put options to the vendors with the lowest costs; that is, those who should be willing to pay the most for them. This creates an immediate profit for whoever receives an allocation either for free or at a price below what would occur in an auction. If they are not auctioned, the initial allocation of such option contracts is therefore more clearly a distributional issue.[27] For example, the Green Climate Fund could provide National Funding Entities with free put options. These entities, in turn, might then auction the put options to vendors, raising funds for the national entities to pursue other activities.

4. Evaluation of QP Instruments

Each of these instruments will have advantages and disadvantages for various stakeholders. Given the nature of the transactions involved, some advantages to the one stakeholder will inevitably be disadvantages to another, and vice versa.

Are they cost-effective?

All QP instruments have the potential to be cost-effective, in terms of providing the maximum amount of verified emissions reductions for a given amount of public funds, *if* they are allocated through a competitive auction mechanism. The transferable put option can be cost-effective in a more limited sense without an auction: this instrument will encourage the cheapest available emissions reductions regardless of how the options are allocated, as the options are bought and sold in a secondary market. Without a competitive auction, however, some public funds will become transfers (or excess profit) to those receiving the options. Such transfers will probably exist when other QPs are allocated without an auction, but some public funds will also end up paying for higher priced emissions reductions.

Do they require a carbon market?

None of these instruments requires a carbon market, but both the top-up and put option instruments explicitly describe the potential for a market, have features tied to that market if it exists/emerges, and automatically deliver reductions to the market. A direct purchase instrument may or may not reference a market, and emissions reductions acquired with a direct purchase instrument may be retired or may be sold into the market. The top-up and put option instruments could also be coupled with a programme to purchase and retire credits, if that was desired. In this way, all of the QP instruments can be designed either to retire credits or sell them into a market.

Table 1 highlights how the different instruments behave, both when a carbon market exists and prices are higher than the QP contracted price, and when either carbon markets do not exist or the market prices is below the contract price. With the exception of the direct purchase instrument, the amount received by the vendor is always the higher of the market or QP contract price. The direct purchase instrument always pays the contract price. Where the real difference occurs is whether the instrument

[27] Free allocation of QPs is generally a distributional question, as recipients are getting something, presumably valuable, for free that non-recipients are not getting. Transferable put option QPs, where there might well be a market price for reselling those options, makes that distributional feature even more transparent.

automatically delivers the contracted reductions to market, and whether the funder pays the full contract price or not.

Table 1 Outcomes under various QP instruments and different market prices versus the QP contract price.

	Market price > contract price			No market or Market price < contract price		
	Fund pays	**Vendor receives**	**Credits end up in market?**	**Fund pays**	**Vendor receives**	**Credits end up in market?**
Direct purchase	Full contract price	Full contract price	No, but fund could sell at higher market price	Full contract price	Full contract price	No, but fund could sell and recoup some of costs
Top-up instrument	Nothing	Market price	Yes, but fund could buy back at higher market price.	Difference between contract and market prices	Full contract price	Yes, but fund could buy back and incur full contract price.
Put option*	Nothing	Market price	Yes, but fund could buy back	Full contract price	Full contract price	No, but fund could sell

*In the put option variant, the fund also receives any proceeds from the initial sale of put options. With a competitive allocation mechanism, this should appear as a higher contract price compared to the top-up or direct purchase mechanism.

Are purchased emissions reductions credits retired or sold into the market?

As just noted, all three QP mechanisms can be used to retire emissions reduction credits or to sell them into the market. However, as Table 1 highlights, the three instruments differ in how they initially deliver the reductions and how much the funder pays. The direct purchase instrument more naturally lends itself to retirement, as the credits are purchased and will (by default) be retired unless subsequently an effort is made to sell them. By the same token, the cost to the funder is the full contract price, unless and until the reductions are sold into the market. The top-up instrument more naturally lends itself to selling into the market, as the funder initially pays just the difference between the specified top-up price and the market price to the instrument holder, who has just sold the emissions reduction into the market. Retirement would require the funder to purchase a credit from the market and then retire it.

The put option remains in between these two instruments: if the option is executed by the vendor holding the put option (because the strike price exceeds the market price), the funder will be left holding the specified emissions reductions analogous to a direct purchase. If the option is not executed (because the strike price is below the market price), the contract expires and the funder holds no credits to retire unless he goes to the market and purchases them, analogous to the top-up instrument.

Should emissions reductions be retired or sold into the market? Either choice serves to jump-start the market for emissions reductions. If that market emerges, retiring credits leads to more emissions

reductions; selling credits into the market frees up public funds for other climate-related purposes (which might include financing emissions reductions in other, non-market sectors). One's preference for one or the other option therefore depends on the weight given to these different uses.

In whose name is the reduction claimed?

One key political question is: who gets recognition for the achieved emissions reductions? In theory, all three options would allow either contributing or beneficiary countries (or neither) to claim all or partial praise or merit for the resulting emissions reductions. This may, in part, depend on additional implementation details.

If recognition is given, strictly bilateral funding systems will require a clear determination of how it would be shared between the two parties. In multilateral contexts, such as the Green Climate Fund, this would mean a determination of how such recognition is allocated among the relevant contributors.

How well do they address non-performance?

Non-performance occurs when a vendor has agreed to deliver verified emissions reductions in exchange for a specified payment, but fails to do so. As noted earlier, all QP instruments pay on delivery, so in the case of non-performance, no payment takes place and public funds remain available for other purposes. However, issuing the commitments to make QP payments will require public funds equal to the scale of the QP payments to be made available from the time of the commitment until payment is made or the commitment expires. Thus, non-performance will still imply that public money has been tied up for some period of time, and no reductions will have occurred. This will undoubtedly frustrate both funders and other vendors. Non-performance is well-documented[28] in a variety of reverse auctions of direct purchase instruments for renewable power (see Box 1).

Direct purchase and top-up instruments can address this kind of non-performance through more stringent participation criteria, bonding, or penalties for non-performance. However, these approaches can also deter participation. Transferable put options offer an alternative solution, creating incentives for non-performing vendors who hold such instruments to sell them to vendors who will perform.

5. Implications for public-sector funders: The need for balance and adequacy

When coupled with a competitive allocation, QP instruments can maximize achievable emissions reductions within the scope of eligible activities and using the public funding in question. A key prerequisite for cost-effectiveness is that the QP instrument will be able to attract as many potential project developers and investors as possible. It may be true that QP instruments organized by international agencies would be able to attract more international than domestic vendors, and vice versa for National Funding Entities. Both groups of vendors are key to the cost-effectiveness of QP instruments, suggesting the need for a careful balance in attracting international and national participants.

It is also important to recognize that the drive for cost-effectiveness may lead to a 'regional' concentration of the funding flows, as happened in the case of the CDM. As mentioned above,[29] this gave rise to strong criticism, particularly from developing countries that were left out (viz. African

[28] Wiser (2002); Council on Energy, Environment and Water, and Natural Resources Defense Council (2012).
[29] Section 1.

and Least Developed Countries). One way in which such geographic imbalances could be addressed is to apply a two-tiered approach: allocate overall funds into geographical windows based on political criteria to achieve a desired geographic balance, then proceed to use QP instruments within each funding window. One would need to be careful, however, about carving up QP instruments into windows that are too small to attract sufficient private sector participation. Another way could be to keep a single 'global' QP window, and deal with the imbalances through other non-QP funding windows.

Any approach will necessitate decisions on balancing overall cost-effectiveness with concerns about equity, particularly the kinds of concerns that have arisen already in the context of the CDM. Such equity concerns undoubtedly will be among the most difficult to work out.

Another similarly difficult issue is how to ensure a adequate supply of public funding to be able to contract at the desired scale.[30, 31] The one potential advantage of QP instruments in this arena is that they could increase confidence among contributing countries to provide more public funds upfront, in the knowledge that disbursements will occur only after emissions reductions have been delivered and verified.[32]

These central issues of balancing cost-effectiveness, allocation, and adequacy of supply will have to be addressed as new public funding sources, such as the Green Climate Fund, are developed.

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[30] Credibility will be even more relevant for *ex post* QP instruments that do not include *ex ante* contracting. With *ex ante* contracting, the contracting agency must already have funds set aside to cover the contracted purchase (e.g., GAVI 2012). Without such contracting, the status of funds is less clear. Yet mitigation investments are as unlikely without credible sourcing of funds as they are without a predictable carbon price in a trading system.

[31] For some contributing countries, the timing of their commitments could be an issue. Here, some innovative work has been done by the International Finance Facility for Immunization (HM Treasury 2004).

[32] See, for example, Ghosh (2010).

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