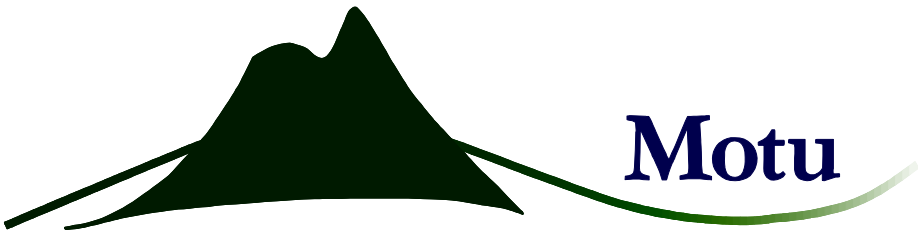

Going to the Source: Using an Upstream Point of Regulation for Energy in a National Chinese Emissions Trading System

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Motu Working Paper 14-09
Motu Economic and Public Policy Research

September 2014

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Acknowledgements

We gratefully acknowledge the Aotearoa Foundation for support through the Shaping New Zealand's Low Emissions Future project; the Institute for Public Administration from the Chinese Academy of Sciences (IPA-CAS); participants in the emissions trading workshop organised by the IPA-CAS and the Fraunhofer Institute for Systems and Innovation Research in Beijing 2013 for fruitful discussions from which this work evolved; Catherine Leining, Corey Allan and several interviewees for input on the New Zealand system; and Robert Stavins and Mark Thurber for useful comments on an earlier draft. All opinions and errors are the responsibility of the authors alone.

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 ISSN 1176-2667 (Print), ISSN 1177-9047 (Online).

Abstract
There are many choices within the design of an emissions trading system. In this paper we focus on one specific aspect – the point of regulation for the energy sector. This choice affects transaction costs; comprehensiveness, and hence the amount of emissions covered and the extent to which the potential cost-effectiveness gains are realised; and credibility of the system. We discuss how an "upstream" energy sector emissions trading system works and present arguments for going upstream (in particular, simplicity of administration) while also discussing arguments for other points of regulation in light of the Chinese circumstances. We present experiences with the New Zealand system, the only system that is entirely upstream for energy, showing ways to address issues that may arise with an upstream system. Ultimately the success of emissions trading depends on markets that operate in a relatively free and competitive way. Simply copying others' systems to the context of a largely controlled economy such as the Chinese one is likely to be ineffective; each system must be uniquely tailored to local circumstances, possibly in China more than ever before.

JEL codes
Q54, Q56, Q58, Q48, H23

Keywords
Emissions trading scheme, point of regulation, upstream, energy sector, China, New Zealand

Contents

1. Introduction[1]

An emissions trading system (ETS) must be designed to match each country's specific context if it is to be acceptable and effective. It must consider the objectives – which in China will likely include mitigating climate change but also improving efficiency and reducing local air pollution – and the constraints, such as limited institutional resources and capability. Climate change is a global phenomenon and addressing it effectively requires that we build global cooperation using a diverse set of institutions (Ostrom et al. 1999). Experience (Ostrom 1990) and non-cooperative game theory as applied to management of the commons (e.g. Seabright (1993)) and the literature on social norms (e.g. Ostrom (2000)) shows us that we can cooperate, but only if we can observe others' efforts. Emissions are one proxy for effort; a carbon price that is not offset by subsidies or exemptions is another. Thus a successful system must reduce local emissions, be transparent and credible (within and outside China), and be simple to operate. In the case of carbon dioxide emissions from the energy sector at the national level, these factors serendipitously coincide. The most credible, comprehensive and effective system is also the simplest.

Cap and trade systems, upon which emissions trading is based, and taxes are attractive because they offer greater cost efficiency relative to many other regulatory instruments. Within fixed limits on emissions (or prices) in the system as a whole, they give private entities flexibility in how they respond and induce them to use their private information about mitigation opportunities.

There are many choices within the design of an emissions trading system.[2] In this paper we focus on one specific aspect – the point of regulation for the energy sector. Existing emissions trading systems have chosen a variety of points of regulation. New Zealand's system (NZ ETS) is the only one that is entirely upstream for energy, though some carbon taxes have been applied at this point. This choice affects transaction costs; comprehensiveness, and hence the extent to which the potential cost-effectiveness gains are realised; and credibility of the system. Fischer et al. (1998) and Hargrave (1998) proposed an upstream point of regulation for energy in the United States, and USCBO (2001) also evaluated an upstream option. More recently, (Stavins 2008) also makes a case for an upstream option in the US. CCAP (1999)

[1] A later version of this paper has been published as Kerr, Suzi and Vicki Duscha. 2014. "Going to the Source: Using an Upstream Point of regulation for energy in a national Chinese emissions trading system." *Energy and Environment* 25(3&4): 593–611

[2] Tietenberg (2006) provides an excellent guide to the design of, and experience with, cap and trade systems. Kerr et al. (2012) provides an analysis (in the Chilean context but largely generalisable) of the design of an emissions trading system in an emerging economy.

discuss point of regulation options for the European Union (EU). Small and Kerr (2007) discuss point of regulation options for the NZ ETS. And in a report for the World Bank Partnership for Market Readiness (Kerr et al. 2012), Chris Dodwell led a chapter that addressed point of regulation. Here, we concisely synthesise these arguments, complement them with new insights and experience from implementation, and discuss the issues that may arise in the Chinese context.

In section 2 of this paper we discuss how an upstream energy sector emissions trading system works. Section 3 presents the arguments for going upstream, while section 4 presents arguments for other points of regulation. In section 5 we briefly discuss the choices and experiences of other existing emissions trading systems, and finally in section 6 we raise some questions about how China might best explore this issue when designing a national emissions trading scheme.

2. How Does an Upstream System Work?

The first, critical requirement for an effective ETS is that it constrains emissions, making the ability to emit scarce. This makes the price of emitting positive, so that individual and company decisions relating to emitting activities reflect the environmental constraint. A positive price changes the decision-making calculus in ways that lower financial barriers to emission reductions that companies and individuals want to make, and provide incentives or penalties for those who are not motivated to reduce emissions without regulation. Fossil fuels, and particularly those with higher emissions per unit of energy provided, will face higher emissions costs. Intermediate and final products produced using fossil fuels will also become more expensive because the costs of their production will rise. This will encourage reduced use of fuel and products embodying it, and movement towards cleaner fuels. It will also make clean investments and development of new technologies that cause fewer emissions more attractive. The emission price will complement other policies that help move toward a low emissions future for China.

The point of regulation in an ETS is the entity that is required to report a defined set of information and surrender emission units. In any industry, there is a vertical chain of production and consumption, with several 'layers' from initial production to final consumption. In an upstream ETS, the information reported is used to model the greenhouse gas (GHG) emissions relating to the (entire) chain of production.[3] The point of regulation must then surrender

[3] Even in an upstream system, some emissions (such as emissions from fossil fuel production) may not be included depending on the exact entity regulated and also on whether the fuel is domestically produced or imported.

sufficient emission units to match those greenhouse gas emissions. Within the energy sector, emissions are driven entirely by the type and quantity of fuel burned.[4] This means that if the regulator can measure the quantity of fuel that enters the chain, they can accurately assess emissions. Fuel usage can be estimated by monitoring production and import (net of export) of fossil fuels.

Transmission of incentives in an upstream system depends heavily on price pass-through as an even smaller fraction than usual of mitigation options can be exercised by the regulated entity itself. Putting the point of regulation upstream embodies an emissions price in the price of fossil fuels. For example, the price of each grade of coal increases by an amount linked to its emissions when burned, based on standard emission factors. When a legal obligation to hold rights is placed on producers and importers of fuel, the cost of that obligation will usually be shared by all parties in the chain of value. Because of the extra cost imposed on the point of regulation (the cost of meeting the obligation), prices rise at all points along the chain, including for final consumers. The share of extra cost that each layer bears depends on mitigation options and competitive conditions within the supply chain, which vary by industry. Price pass-through can be constrained by regulation (especially in the electricity industry) and by lack of competition. These issues tend to be strongest in the short term. Economies that do not pass real costs through to producers and consumers face efficiency and equity problems that go beyond emissions trading.

As long as conditions are competitive and prices pass efficiently through the chain, the point of regulation does not affect the incentive or ability of any party to mitigate. The ability to respond varies by sector and layer, but is independent of the point of regulation. Emissions trading allows regulated entities to acquire mitigation from third parties rather than undertaking their own mitigation activities. For example, a fossil fuel producer whose customers find it difficult to reduce their demand in the short term can purchase emission units rather than reducing production. Another point of regulation supplying a more responsive industry must then reduce its production or imports to compensate. It is rewarded through profits from the sale of units. This trade reduces the social cost of mitigation, and thereby also reduces the economic burden throughout both supply chains. It follows that there is no need for the regulation to be imposed on the entity most capable of mitigating (or any other party for that matter).

[4] How fuel is burned has an insignificant effect. Some adjustments need to be made for petroleum products used in the petrochemical sector. Carbon capture and storage would need to be rewarded with units. Any entity that carries out carbon capture and storage could voluntary choose to become a point of regulation if it is not already.

The way the economic burden is shared between parties in the chain is also independent of the point at which the legal obligation is placed, provided accurate targeting of greenhouse gases can be achieved at all points and there are no constraints to price pass-through. The burden finally borne by each entity depends on the higher prices they face for fuel or products that embody fuel, the amount of fuel and products they use, their ability to pass on those costs, and any free allocation given to them by the government. Free allocation can be given to any entity. If that entity is not a point of regulation, it can simply sell its allocation to others to offset its costs.

3. Conceptual Benefits of Going Upstream

There are three key arguments for an upstream system: low transaction (administration and compliance) costs; comprehensive coverage; and external credibility.

3.1. Low Transaction Costs

Why are low transaction costs a good idea and why can a national-level upstream system deliver them? Transaction costs do not benefit anyone except perhaps the lawyers, accountants and bureaucrats who have more work as a result. They deflect energy and resources from mitigation of emissions. This is particularly critical in countries where human capital is scarce and institutions are weak. A more complex system with higher transaction costs is also less transparent, which creates issues with credibility – as discussed below.

The lowest transaction cost system will be one that involves some combination of a small number of administratively competent players and data that are already collected or easy to collect. An upstream system essentially collects data on production, import and export of fossil fuels. Trade statistics are generally well collected – and can be verified by the other party to the trade. Production may be more complex if there are large numbers of small producers. The best point of regulation could either be the producer or a next point in the chain, such as a gas-line operator or fuel transporter. Sometimes many small producers will sell to one large entity further down the chain. Some entities will be larger, more concerned about their reputation (and therefore more likely to provide good-quality data) and less easily corrupted than others. This choice is a country-specific issue that depends on the specific industrial structure.

Even with an upstream system that has a carefully chosen point of regulation, there will be some very small actors for which the administrative costs of inclusion will not justify the potential benefits. In the energy sector, an upstream threshold may apply to the quantity of fuel, such as the tonnes of coal imported or extracted. Such a threshold could be used to exclude

small-scale providers of firewood. The definition of thresholds must be easy to determine and not easily manipulable over time. It is undesirable to have a situation where firms break into small parts to avoid regulation.

3.2. Comprehensive Coverage and Accurate Targeting

An upstream system automatically achieves very high levels of coverage. Any firm or consumer who consumes fuel directly or as embodied in products faces the cost of emissions and is encouraged to reduce them. If the point of regulation moves downstream, the number of entities involved rises and the share of emissions covered generally falls as small entities are excluded. Why is this important? There are three reasons: efficiency; to avoid leakage; and fairness.

There is no silver bullet for mitigating greenhouse gas emissions. Carbon is used throughout the economy and the opportunities to increase efficiency, change fuel use, innovate and adopt new technologies are ubiquitous. An upstream price signal that is effectively passed through encourages all actors to consider all mitigation opportunities even if they do so unaware of the emissions impact.

If any group or activity is excluded, achieving a particular emissions limit is harder and higher emissions are therefore likely. This is particularly critical for countries and sectors with a high level of informality and small firms. Developing countries tend to have many firms that are not official and hence will not be incorporated in an emissions trading system if they need to be points of regulation. They may also have a disproportionate number of small firms for whom the administration costs of being a direct point of regulation would outweigh any benefits. In an upstream system these sources can all be covered.

Another efficiency issue is accurate targeting. A fossil fuel producer does not need to know anything about its customers' activities to pass on an efficient price signal – it simply raises the cost of fuel to reflect it. In contrast, if electricity retailers were the point of regulation, they do not control or even know the source (and hence emissions profile) of power they are supplying to end users because power generally comes through integrated grids. Thus they cannot alter their prices to reflect emissions accurately, and incentives to change fuel use in electricity generation are muted. Even in an upstream system it is difficult to pass efficient prices to end users to reflect variations in emissions across seasons and times of day but, depending on the form of regulation, retailers will face clearer incentives and can choose how much to pass on.

Leakage is where one entity reduces emissions (directly or indirectly) by reducing production, but the emissions simply move elsewhere because consumption does not fall to

match it. Within a country, leakage can occur if some sectors or firms within sectors are covered while others are not. For example, in a system where large energy users are points of regulation, the firms may choose to contract their most emissions-intensive processes to small firms, thus avoiding the emissions cost. Similarly, if electricity generation, provided by large electric utilities, was covered but household fuels, provided by small informal firms, were not, households would have an inefficient incentive to move away from electricity. Within-country leakage is much less likely to occur within an upstream system.

Finally, a system that includes some firms but excludes others that are very similar, either because they are a slightly different size or are in a slightly different sector, will be perceived as less fair given that they both have similar environmental impact, and hence will face more resistance. Such a system may be harder to implement and less effective in terms of emission reductions.

3.3. External Credibility and Linkage

Developing countries are making significant capital investments, including in major infrastructure, and often have low levels of efficiency in energy and other materials use. Therefore, their opportunities to mitigate climate change are likely to be greater than their willingness to bear cost, given other urgent priorities and opportunities with very high returns. Developed countries, in contrast, have few easy mitigation options relative to their willingness to invest in climate mitigation. Given that greenhouse gases spread through the atmosphere, it does not matter where mitigation happens. The critical thing is that it is sufficiently credible and additional (would not have happened otherwise) that the developed country finds it more attractive to invest in mitigation in, for example, China than in its own country.

We measure (proxies for) emissions, not reductions. When reported at a national scale, the critical issue is that emission measures from each entity are unbiased. Precision at every entity is less critical for credibility because unbiased errors will average out in a large sample. The data used to estimate emissions are ideally auditable and verifiable, and the calculations should be easily replicated, involving as little discretion as possible. This builds confidence that emissions data are credible, so that reductions in emissions relative to a prior agreed forecast are more likely to represent real reductions.

A national-scale upstream system requires production and import/export data. The latter can be verified using data from trading partners. Production data are more difficult to verify, particularly from small producers, but are still much easier to make reliable than estimates from

large numbers of downstream entities, particularly where leakage to uncovered entities may be significant.

Good-quality upstream energy data provide an effective proxy for reduction in both production of fossil fuels and consumption of greenhouse gases. Confidence in these proxies for effort to reduce emissions can help build international cooperation, by reducing arguments about whether actions are real and additional and efforts are genuine, and focus efforts on how best to mitigate.

If other countries choose to purchase units from a developing country's upstream emissions trading system, they will have confidence that the total cap is reducing and hence that real emissions reductions are being made. This is then likely to increase the flow of funding.

4. Arguments for Other Points of Regulation

4.1. Getting Attention of Firm Decision-makers – Is This the Best Way?

A common argument for regulation at downstream points in the energy chain, where the most significant behavioural change might be expected (points of emission where efficiency and fuel choices are made; or final energy user where consumption and technology/appliance choice decisions are made), is that complying with regulation, in itself, creates greater management focus on emissions management and reduction.

If the emissions trading system is the only policy instrument, and being directly regulated gets the attention of company boards, this may be true. Because emissions costs, and climate change mitigation, are relatively new issues and involve different decisions than those firms are accustomed to and structured to deal with effectively, an effective response may require board attention. There is some evidence from the United Kingdom that the management focus on energy savings through the target-setting approach under their Climate Change Agreements (CCAs)[5] to undertake actions to mitigate emissions helped to galvanise action. (Bowyer et al. 2004), based on interviews with participants, stated: "the CCAs … helped to raise the issue of energy higher up the business agenda. The agreements also created ownership of energy issues in those businesses which entered into them and, at a practical level, facilitated dialogue between industry and government." They also note, however, that exemption from 80 percent of the Climate Change Levy (a very high marginal incentive for the reductions achieved) was "an indisputable incentive" for the firms. It appears that the high implicit price, combined with direct

[5] These were negotiated agreements between government and large energy users, allowing firms to undertake actions to mitigate emissions in exchange for partial exemption from other regulation.

engagement, was effective. Case studies on firms in the German power sector indicate that the EU ETS had a similar effect, i.e. resulted in the perception of carbon dioxide emissions as one factor in firms' decision processes (Bowyer et al. 2004; Rogge and Hoffmann 2010). Again, however, they do not distinguish the price effect from any effect of direct engagement through making firms a point of regulation.

There is thus no evidence that the ETS point of regulation itself is critical to getting effective firm engagement in emission reductions. If boards, and those responsible for legal compliance within a firm, needed to be engaged directly in responding to the cost of every input, that would be extremely inefficient internal management. Because this is a new issue to which firms may not otherwise pay a socially efficient amount of attention, it may be valuable to have some form of education and engagement to complement the emissions price. This education can, however, almost certainly be most effectively achieved separately from the direct regulatory interaction and, to a certain extent, will be provided by private sector consultants.

4.2. Don't Want Comprehensive Coverage

It can be hard to identify the destination of fuels across sectors using upstream data. This is an issue if the government chooses to exclude some downstream sectors. For example, the Australians chose to monitor coal use at the point of emission because they wanted to avoid imposing a cost on coal that is exported (Kerr et al. (2012), chapter 2).

Countries may be concerned about imposing a full carbon price on specific sectors for three reasons: it is politically difficult in their context (this is sometimes combined with arguments that little mitigation would occur in response to a price signal);[6] fear of loss of competitiveness and leakage; and concern about well-being of consumers who will face higher prices.

All countries are concerned about the potential for loss of competitiveness and leakage from imposing emissions costs on emissions-intensive trade-exposed sectors. One way to address this problem is to exclude the sector, although this may make an upstream system more complex. However, the most common approach to this problem is either to provide free allocation to particularly exposed firms on the basis of future output (this is done in New Zealand and California, and was done in Australia (Kerr et al. (2012), chapter 6).[7] Concern about

[6] The EU and Australia have both excluded road transport from their systems and California has chosen to introduce it in a later phase.

[7] In the EU free allocation has not been done on the basis of future output (except to the limited, and distorting, extent of removing eligibility to units if a firm closes), particularly in the first two phases, so has had a limited protective effect against leakage. The EU has moved toward allocation on the basis of benchmarks, but with historical output data, which comes closer to output-based allocation to the extent that the allocation is updated in each phase.

consumers (usually electricity consumers) can also be addressed using free allocation (e.g. in California) or by auctioning some units and using the revenue to help low-income households (e.g. in Australia taxes were reduced for low-income people).

Although free allocation for the purposes of protection of firms or consumers requires data on emissions at a downstream level (e.g. of trade-exposed firms), if used, this free allocation should be given on the basis of measures of output going forward, not emissions, to avoid perverse incentives to increase emissions. Historical firm-level emissions data are used only as part of a benchmarking process to create the factor by which output is multiplied (see, for example, the recent shift to benchmarking for carbon-leakage-exposed industry in the EU ETS). There may be some advantages of a downstream point of regulation for data collection in the implementation phase if some of the same firms would be regulated and receive free allocation, but the data requirements diverge thereafter. Thus the point of regulation can be separated from the issue of free allocation of allowances and the protection of either trade-exposed firms or consumers.

A related issue arises for schemes that are not at a national scale. Regional emissions trading systems are more vulnerable to leakage because trade, and firm and labour migration flows, tend to be stronger within than between countries. Regional schemes also have different data needs that may not be met by existing upstream data infrastructures. Trade flows within countries are not monitored as clearly as they are at national borders, so 'import' or 'export' of fossil fuels between regions may be hard to observe.

California is a good example of this. It wanted to cover all emissions from electricity usage, but much of the electricity used in California is produced elsewhere. If the state had regulated only upstream fuel inputs used within California, many of its emissions would not have been covered and locally produced electricity would have been at a disadvantage, as would local alternatives to electricity. Thus California regulated electric utilities and out-of-state electricity suppliers.[8]

4.3. Match Existing Regulatory Structure – Use Existing Data and Institutions

Different countries have different systems for collecting data. This can affect the administration cost at different points of regulation. A key reason for the implementation of the European system at the point of emissions rather than upstream was that the Integrated

[8] This has created difficulties, and inevitably leads to contract reshuffling to reduce the apparent emissions associated with the electricity. This issue is discussed in Fowlie (2009)and Bushnell (2013).

Pollution Prevention and Control regime already operated with these entities, so there were established systems and relationships. When implementing an emissions trading system, the existing data-collection infrastructure should be used as far as possible. Parallel systems should be avoided to reduce transaction costs.

4.4. (Regulatory) Barriers or Market Power Mean That Prices Won't Pass Through

Because energy supply tends to be dominated by large players, and tends to involve infrastructure that can create natural monopolies, electricity and other energy markets are often regulated. In the short term in particular, this can block price pass-through. If the regulatory system is unable to pass through higher costs, upstream emissions trading will not lead to carbon price incentives and effective downstream mitigation. However, an energy system that cannot respond to changes in costs is unlikely to function effectively; eventually, costs need to be passed through to avoid energy shortages and blackouts. The introduction of an upstream emissions trading system would ideally be matched with a reform of the regulatory system to facilitate price pass-through.[9]

In contrast to the argument that prices may not be passed through enough, the opposite may occur in less regulated energy systems. Upstream companies may pass through too high a cost of emissions either because they manage the emissions allowances poorly (e.g. buying when the market price is high) or because this is an additional opportunity to exercise market power. This has been a contentious issue in New Zealand – see below.

If the problem is poor management of emissions units, or a desire to manage emissions risks jointly with other correlated risks, a downstream entity that is not a point of regulation could contract to manage its own emission obligations. Producers of high-sulphur coal did this within the US Acid Rain Program; they sold coal together with matching sulphur dioxide allowances to electric utilities.

5. International Practice and Experiences

Table 1 summarises the point of regulation choices in the energy sector in four key emissions trading systems. In addition, it outlines the implications for coverage and indicates some of the reasons for the chosen approach. Here we will focus on the one country that chose an entirely upstream system – New Zealand – and explore some of its experiences.

[9] Households and small firms are not directly involved in either upstream or downstream markets. Problems can arise in pass-through of incentives at this level – e.g. the incentive for landlords to invest in insulation if the tenant pays for heating. These 'principal–agent' problems cannot be addressed through choice of point of regulation.

Table 1 Coverage and point of regulation for energy sectors in four key existing schemes (adapted from table 2.1 in Kerr et al. (2012)).

	Geographic and sectoral coverage and phasing	Emissions coverage	Point of regulation and regulated entity	Rationale for approach
European Union ETS	• From 1 January 2005. • Now covers 31 countries and around 11,500 installations, which are owned by about 5000 companies. • The following sectors are now included: power combustion; oil refining; coke and steel; cement and lime; glass, bricks and ceramics; pulp and paper; chemicals; aluminium; and aviation.	• The EU ETS collectively covers around 50% of EU CO_2 emissions and 43% of total GHG emissions.	• Point of emissions for all participants. • Site-based scheme.	• Belief that site-based energy managers have the greatest influence over implementing projects to improve the efficiency of power generation and energy-intensive industry and will respond best to direct participation. • Approach is similar to existing regulation, i.e. Integrated Pollution Prevention and Control regime. • Political resistance to central regulation of other sectors (e.g. transport). • Resistance to a system that appears too similar to a tax.[10]
New Zealand ETS	• From 1 July 2010, emissions from stationary energy and liquid fossil fuels.	• Covers all GHG emissions from the energy sector.	• Upstream at point of production/import of fuels in the energy sector; option for large users of aviation fuel to opt in as direct points of regulation.[11]	• Belief that costs passed through to emitters in the price of fuels will lead to equal incentives to pricing at the point of emissions, but with broader coverage and lower administration burden due to fewer regulated entities upstream.

[10] Skjærseth and Wettestad (2010) say that the EU tried to implement a carbon/energy tax for several years but it was not possible. An upstream system would have been interpreted as a tax, and thereby under the EU constitution would also require unanimity in the Council of Nations, which the EC knew it could not get because of objections by countries in the "new Europe," such as Poland. The downstream emissions trading scheme was developed in the context of this experience.

[11] This has been extended to other large fuel users in 2013.

Table 1 (continued).

	Geographic and sectoral coverage and phasing	Emissions coverage	Point of regulation and regulated entity	Rationale for approach
California ETS	• From 1 January 2013. • Covers *c*. 350 businesses, representing 600 facilities in California. • 2013–14: covers electricity-generating and industrial facilities exceeding 25,000 tonnes of CO_2e per year. • 2015–17: will add distributors of transportation, natural gas and other fuels. • 2018–20: will include transportation fuels.	• Over time will cover all major sources, representing 85% of California's GHG emissions.	• Upstream at liquid fuel supplier for transportation as of 2015. • Point of emissions for all others. • Businesses are obligated, not sites.	• Emissions reduction target covers all electricity consumption within the state; therefore the scheme had to obligate all fuels, even from suppliers located outside the state.
Australian Carbon Pricing Mechanism	• 1 July 2012–2014(?)[12] • Covers 500 large emitting facilities (i.e. more than 25,000 tonnes CO_2e per annum). • The following energy sectors are included: stationary energy, fugitive emissions processes (with the exception of decommissioned coal mines), non-legacy waste and some parts of the transportation sector (domestic-based aviation, shipping and rail emission are covered, but transportation fuels will not be covered).	• Accounts for *c*. 60% of Australia's GHG emissions.	• Point of emissions for electricity, site-based. • Upstream for gas at point of import, or business-based for large gas suppliers if they volunteer to take on the liability.	• Coal cannot easily be regulated upstream as it would be very difficult to split domestic consumption from coal that is exported.

[12] As at the time of writing, the law defining the system was in the process of being repealed.

New Zealand has an upstream emissions trading system with an option for a small number of large firms that are downstream to opt in as points of obligation. Here we discuss the logic of the option to opt in, and experiences with the upstream system overall and with the opt in specifically. To add to our personal observations on the experience with upstream emissions trading, we draw on interviews with government administrators, a market broker, a carbon market expert in a major business organisation and a carbon trader from a large company that chose to opt in as a point of regulation.[13]

New Zealand chose an upstream system because it was generally believed that a comprehensive system with low administration costs and a price signal that would pass throughout the economy and provide efficient incentives would work best in that context. All those interviewed are supportive of this – and it has not been challenged during review processes.

The only issues that arose were that some large downstream companies felt they were paying higher carbon prices than was necessary. This arose for two reasons: some upstream points of obligation were not considered to be very good at managing carbon prices (e.g. coal companies do not have much experience in trading commodities relative to power companies); and market power meant that upstream firms may be able to pass through carbon prices that are higher than the market price. In other words, the issues were competence and competition.

We cannot observe emission trading competence, but if it is the only issue, the upstream and downstream firms can mutually benefit by privately contracting for the downstream firm to manage the emission units and provide units to the upstream point of regulation as it purchases fuel. This has occurred. The only issues have been the transaction costs of agreeing how to do this, and ensuring that units are available to the upstream firm in a timely way for compliance. The gains from this could be high. One downstream company that opted in says that it has saved millions of dollars by managing its own carbon liabilities.

A situation where the upstream actor also has market power is more complex. There may be mutual gains from the downstream entity managing the carbon, but contracting to do this imposes not only transaction costs on the upstream entity, but also takes away its ability to exert market power by passing on high carbon prices. In theory, if a firm has market power, it will already be extracting all the monopoly rent it can in the absence of carbon. It should, in fact, be able to pass on less of the carbon price than in a competitive market for the same good.

[13] Corey Allan and Catherine Leining at Motu carried out these interviews on our behalf.

However, there is a strong perception that some upstream entities are passing on carbon prices that are higher than those they are bearing,[14] and one case has even been taken to court.[15] We have been told that one upstream company charged NZ$25 per tonne when the market price was around NZ$2. The way that upstream firms pass on carbon costs is not transparent – but neither are their other cost structures. The upstream liquid fuel companies say "they compete on price at the pump and that carbon is just one more input cost".[16] This needs more careful empirical examination, if appropriate data can be found.

Some upstream companies have refused to negotiate contracts with downstream entities to devolve management of carbon liabilities. This could either be because they are extracting monopoly rent through the emissions market, or because they believe the extra transactions costs associated with separately identifying fuel provided to specific customers are not justified by the benefits from not managing the carbon. Some upstream companies have opposed the opt-in provision for the same reasons.

If market power is being exercised and upstream entities do not manage emissions well, a legal right to opt in is valuable both for equity and to enable better management of emissions units. Although there is apparently relatively little cost to government from a few extra entities opting in, transaction costs are imposed on the upstream entity. Thresholds for legal opt in therefore need to be set to balance the costs against the benefits of opt in.

In the market as a whole, downstream opt in is relatively small. Only 10 out of 99 points of regulation for energy are companies that have opted in; they make up 19 percent of energy sector emissions (NZ EPA 2013).

6. China's Way Forward: Is an Upstream Emissions Trading Scheme an Interesting Option for China's Future National Scheme?

We have summarised the fundamental issues around choice of a point of regulation and how these have led to different choices in each of the systems designed so far. We would argue that, if conditions allow it, an upstream system offers significant advantages, especially to a developing country such as China. We have shown that an upstream system has worked quite

[14] For example, see newspaper coverage: http://www.stuff.co.nz/business/7639672/Power-industrys-carbon-gift (accessed 29 January 2014).

[15] Ibid.

[16] Ibid.

well for New Zealand, a developed country but one with limited administrative capacity. Critically, however, the best system for China depends on local conditions, of which we have no expertise. Here we simply offer some thoughts and questions that arise when observing discussions in China from outside.

6.1. Upstream Advantages in a Chinese Context

We consider first how valuable the upstream advantages (low transaction costs, comprehensiveness and credibility) might be in the Chinese context.

Transaction costs are an important factor in the implementation of emissions trading systems in all countries, but particularly in developing countries where human resources are limited. A simpler system per se should reduce transaction costs, but higher emissions per regulated entity and fewer regulated entities should further reduce them. All countries, but particularly developing countries, are short of highly capable people relative to the opportunities to engage them. A simpler system requires fewer people, and in particular fewer skilled people. The exact choice for the simplest credible system, however, depends critically on the availability, quality and verifiability of data from different entities.

The value of a more comprehensive system depends critically on the distribution of mitigation opportunities across firms of different sizes both now and in the future. It also depends on the risk of leakage from a downstream system that covers only large emitters. Leakage away from large emitters may not be such an issue in China in the short term if firms don't have complete freedom over their level of output. How true is this, how widespread and how long-lasting?

Finally, we would argue that because an upstream system is simpler, it is also easier to verify achievements. This is important to China if a motivation of the scheme is to be seen to be effectively reducing emissions, and even more so if China would like to sell units. China was a major producer of certified emission reductions under the Kyoto Protocol. Two problems arose with certified emission reductions. First, there were concerns about the additionality (in other words, would reductions have happened otherwise) of some of the units (He and Morse 2010); and second, partly as a result of those concerns, the demand for certified emission reductions has dried up. We understand that China is exploring different ways to engage developed countries to facilitate mitigation, including a recent memorandum of understanding with the government of California that may allow some form of linkage into the Californian system. A credible upstream system may facilitate these linkages and increase the flow of investment and funds to purchase units.

Is credibility of the system within China also an issue? In many cases, a regulatory system is more acceptable if regulated entities can easily see that others similar to them are treated equally and that all entities are in compliance. This may be easier to observe in an upstream system – subject to limitations on price pass-through. If entities know that the system is broadly accepted and is complied with, they may also have more confidence that it will persist and may therefore be more likely to invest in response to the system.

6.2. Arguments for Other Points of Regulation

Here, we explore the cogency of arguments for other points of regulation in China: getting attention of decision-makers; desire to exclude some sectors or regions; use of existing regulatory institutions and data; and price pass-through.

Who really makes decisions in China? These are the groups that need to be engaged. Are they associated with specific points of regulation or can they be effectively engaged in other ways? Are they responsive to price signals – and if so how?

China has begun its experience with emissions trading at a regional level and with partial sectoral coverage. Will China want to exclude some sectors or regions in a national emissions trading system? The emissions from some sectors can be relatively easily separated upstream; for others it is harder. Regional schemes tend to use a downstream point of regulation because it is not easy to observe inter-regional flows of fuel. There are three possible arguments for maintaining regional emissions trading systems with linkages between them as part of the national-level design: these experiments could create a regulatory structure that could then form the basis for a national scheme; local co-benefits, such as air quality; and concern that weakness in one part of the system, such as poor monitoring and enforcement, affects the integrity of the whole system.[17] If a decision was made to continue a regionally based structure, it would be hard to use an upstream point of regulation.

However, the arguments for maintaining a regional structure may not be that strong. The regional infrastructure created for the pilot trading schemes will not generate such a strong, comprehensive and low transaction cost system that it will be preferred to a simpler national upstream system on those grounds. The data and relationships created through the pilot process will be extremely useful to inform and gain the attention of the firm decision-makers who will need to identify and carry out mitigation opportunities in any emissions trading system, thus complementing the price signal. They will also facilitate negotiations over free allocation of units.

[17] A fourth possibility is that a region is exempted for political reasons.

Similarly, local air quality can also be effectively addressed while using a national system. One of the most famous emissions trading systems, the US Acid Rain Program (Ellerman et al. 2000), faced this problem of regional differentiation in local pollutants directly. The designers chose to ignore regional variation in favour of a simple, effective system that would lead to very large reductions in sulphur dioxide nationally (a reduction of around two-thirds between 1990 and 2010), and therefore almost inevitably lead to significant improvements everywhere. It has been widely regarded as a great success (Rogge et al. 2011). Since 2008, partly as a result of court decisions relating to interstate trading of emissions, the market has collapsed (Schmalensee and Stavins 2013).

In China, large reductions in fossil fuel use are likely to have similar effects. Later, when demand for even greater air quality is experienced, the emissions trading system could be supplemented with a trading scheme aimed specifically at local air pollution or with supplementary regulations if that is desired.

A key argument against regional systems is that they inevitably create variance in stringency across China and hence can lead to loss of cost effectiveness and leakage. If the choice is made to have a consistent national system, the need to be able to monitor at a regional level (which is one argument for a downstream point of obligation) disappears.

It appears that the pilot emissions trading schemes are having to create new data infrastructures in order to run downstream systems. Thus the argument that use of existing downstream data infrastructure makes a downstream system easy seems unlikely. That said, how easy credible upstream monitoring would be is a matter for local experts to determine.

The most challenging question is to what extent prices pass through an economy that is highly regulated and where many decisions are made centrally. An upstream system assumes that price signals will be passed down through the chain of production. Regulation can block this, at least temporarily. A downstream system assumes that downstream firms can make decisions about investment, production processes and output, and pass costs further down toward consumers. How these decisions are really made in China, and will be made over the next few decades, may affect the choice of point of regulation.

One final set of issues around point of regulation that emissions trading system designers should be aware is that creation of an ETS inevitably redistributes resources. The distribution of costs dominates debate around emissions trading systems. The point of regulation is often

conflated with the entities that receive free allocation of allowances.[18] Distributional issues should not affect the point of regulation in theory, but this perceived connection between the point of regulation and the appropriate entities to receive free allocation could encourage groups to lobby to be the point of regulation. The designers of the regulation and the politicians who negotiate it need to be aware of this potential pressure. This effect can occur across regions or at the firm level.

This cross-regional distributional issue may be important in a large country like China, with significant regional differences and, potentially, some regional government involvement in management of the trading system. There is likely to be a difference between the region in which upstream sources of ultimate emissions are recognised and the region in which the emissions actually occur. Moving between points of regulation could imply redistribution of emission obligations across regions. In theory this could be addressed to maintain the same distributional outcomes through agreements on each region's allocation plan, but addressing the issue may be harder in reality.

Before the implementation of the New Zealand scheme, allowances had been freely allocated to the firms that were points of regulation within almost all tradeable permit systems. Arguments that costs are passed through markets, so may not fall on the regulated entity, were not regarded as compelling in political processes. Thus entities had a strong vested interest in being the point of regulation. This may have influenced system design. This effect is now weaker, partly since Europe experienced huge windfall profits to electricity generators from free allocation and cost pass-through, and given that several countries have innovated with more targeted approaches to free allocation, but it is still the political default.

Ultimately, the success of emissions trading depends on flexible markets that operate in a relatively free and competitive way. The critical issue for cost effectiveness is that the decision-makers have an incentive to inform themselves and use their information on how best to reduce emissions, and have sufficient control that they can implement mitigation actions. In market-based economies (developing or developed), despite specific local challenges, the institutional conditions mostly support this. Working out how the fundamental ideas behind emissions trading can be best applied in the very different context of a largely controlled economy will require that excellent thinkers go back to basics and design a system that works within the Chinese system as it is, and as it is likely to evolve over the coming decades. Simply copying

[18] We see this in international negotiations as well, where despite understanding of the need for differentiated responsibilities, proposed commitments are generally expressed as percentages of recent emissions measured by Kyoto or United Nations Framework Convention on Climate Change (UNFCCC) rules.

others' systems is likely to be ineffective; each system must be uniquely tailored to local circumstances, possibly in China more than ever before. We hope that the ideas in this paper, and the questions we have raised, will help those thinkers with their challenging task.

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