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Emissions trading as a policy option for greenhouse gas mitigation in South Africa

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Abstract
Emissions trading is fast becoming one of the most popular policy *instruments for reducing greenhouse gas emissions internationally. This hybrid instrument combines the certainty of mitigation volume delivered by regulation, whilst also harnessing the power of the market through an economic approach to deliver migitation price discovery and least cost mitigation opportunities. Theoretically, this is a powerful combination.*

However, the realities of uncertainty and lack of information result in international emissions trading experience deviating substantially from the instrument's theoretical potential. This is of particular relevance in a developing country context. Scheme design is therefore very important to counter these market failures, and policymakers are required to strike a balance between this and introducing distortions. Given that the instrument is in its infancy, performance of the various schemes up and running internationally is inconclusive. Emissions trading proponents argue that the benefits will be realised over time, once the initial teething problems are overcome.

The paper is the result of research conducted in 2008 and presented at the South African Climate Policy Summit in 2009. It considers theory and international experience in application to the potential establishment of an emissions trading scheme in South Africa. Lack of data, capacity and experience with markets in the energy sector present complications in the use of the instrument as a central part of the nation's mitigation policy suite, as do market concentration issues. Should an emissions trading be proposed, the paper argues for ways in which its design could address these complications, and align with the current energy security imperative resulting from the electricity crisis in the country, the twin political objectives of poverty reduction and employment creation of the recently elected government, and the timeframes proposed by the Long Term Mitigation Scenarios.

Keywords: emissions trading, emissions trading scheme, greenhouse gas mitigation, Long-term Mitigation Scenarios

1. An overview of greenhouse gas emissions trading

1.1 Emissions trading: defining the instrument

An emissions trading scheme (ETS) is based on the allocation of allowances to emit pollutants, which in the case of climate change are greenhouse gases. Allowances are allocated to a defined set of emitters, who are required to hold sufficient allowances to cover their emissions at the end of a compliance period, or face penalties. Scarcity is created in the scheme through the allocation of fewer allowances than emissions, resulting in emitters having to choose between reducing their emissions in line with their allowance allocations, or purchasing additional allowances to cover their excess emissions levels.

The outcome of individual emitters' choices will be determined by a number of factors, primarily that of cost. Where an emitter can mitigate its emissions cost effectively, it is likely to do so to avoid penalties associated with non-compliance. However, when it gets very expensive to mitigate a marginal unit of emissions, the emitter will look to purchase allowances from other emitters whose mitigation profile is more cost-efficient. Figure 1 demonstrates this process within a simplified two participant scheme. Participant A has a relatively high marginal cost of emissions reduction, whilst Participant B can mitigate emissions at a relatively low cost. Both reduce emissions internally, but B reduces below his allowance allocation, and sells this excess to A. For A it is cheaper to purchase from B than to continue to reduce emissions in line with his allowances. For B, it is cheaper to reduce below his allowance allocation, and then sell emissions at a profit to A. If the market clears, both participant's marginal cost of mitigation is equal, with the participant with the lowest mitigation cost receiving the difference in mitigation costs as revenue.

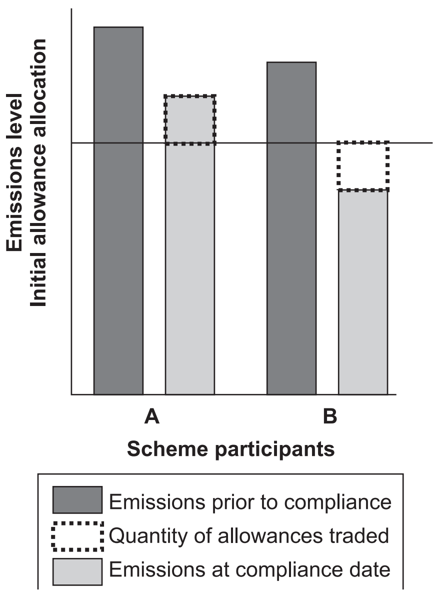

Figure 1: Emissions trading in operation

A market in the scarce emissions allowances is thus created. In theory, this market enables price discovery, the identification of least cost emissions mitigation opportunities, and facilities the least cost suite of mitigation activities to achieve the target implied by the allowance allocation. If targets are progressively tightened, it also encourages dynamic efficiency, as participants are constantly incentivised to innovate to find low cost mitigation opportunities.

ET is a hybrid policy instrument, comprising both a regulatory aspect in its quantitative cap on emissions within the trading system, and an economic aspect in its establishment of a market to deliver mitigation price discovery and least cost mitigation opportunities. The regulatory approach results in certainty of the quantity of emissions which will be reduced (Hovi, 2006), whilst the economic aspect introduces flexibility and mechanisms to manage pricing and risk. Under a situation of full information and certainty around emissions levels and mitigation costs, an ETS would result in the achievement of a set limit of emissions at least cost. However, lack of information and uncertainty can significantly dilute this optimal outcome (Fisher *et al.,* 1996).

There are two types of ETS currently defined. The first is the cap-and-trade scheme described above, where a cap, or limit, is imposed for a defined set of emissions. This emissions set can be defined for a particular country, sector, sectors or type of greenhouse gas. The cap is then allocated as allowances amongst emitters, who can mitigate internally, or trade to hold allowances equal to their emissions at the end of the period. The second type of ETS is a baseline-and-credit scheme. Here emitters receive a limit on emissions relative to a particular baseline, but can sell emissions 'credits', generated by reducing emissions below the specified limit. Many ETS in existence are hybrids of the two. A set of emitters operate under a cap-and-trade scheme, but may purchase credits from baseline-and-credit participants, to assist them in meeting their allowance target. The allowances from the cap-and-trade scheme are set to be equivalent in emissions reduction value as the credits generated under the baseline and credit participants. Most commonly, a tonne of carbon dioxide equivalent (tCO_2e) is identified as the allowance or credit unit.

ETSs can be regulated and made mandatory by the government, or established on a voluntary basis, with companies and organisations signing up to receive allocations or targets. One of the main objectives of voluntary schemes is to prepare participants for a mandatory scheme, and to pilot a scheme to generate data and iron out any design issues.

ETSs are the most popular form of greenhouse gas mitigation policy instruments in effect globally, with the Kyoto Protocol establishing an ETS utilising a hybrid of cap-and-trade and baseline-and-credit (the Clean Development Mechanism and Joint Implementation) at a global level. However, ET still suffers from negative perceptions on behalf of certain stakeholders because of the impression, particularly with grandfathering methods of allowance allocation, that the emitter is paid to reduce emissions, as opposed to being punished for emitting.

Theory suggests that market-based approaches may be more successfully applied in circumstances where well developed market systems already exist in the underlying product (for example, energy) markets. Although, the adoption of a market based emissions mitigation policy approach may speed the adoption of the underlying market systems (Fisher *et al.,* 1996).

Trading schemes have also been used as a policy instrument to target objectives related to greenhouse gas mitigation, in particular those of supporting renewable energy and energy efficiency. Where energy is largely generated from fossil fuel sources, these schemes will also achieve a degree of greenhouse gas mitigation. Energy schemes can be made compatible with ET, depending on scheme design.

An advantage of ET over other economic instruments is the potential it has for enabling sophisticated risk management by participants. This is particularly true if the scheme allows intertemporal use of credits (banking and borrowing), to smooth the emissions mitigation investment cycle. (Fisher *et al.,* 2006). In theory, ET should stimulate innovation in emissions mitigation technologies, as the potential to sell surplus credits provides an incentive for emitters to exceed their targets.

1.2 ETS as an emissions mitigation policy instrument: design considerations

Design of an ETS is critical to its success. ETS enables the achievement of a specific quantity of emissions reduction at least cost, in the circumstance of full information and certainty (Fisher et al, 1996). However, in the area of greenhouse gas mitigation, particularly in a developing country, these conditions are far from satisfied. The way the scheme is designed can assist in combating the lack of information and certainty to some extent. This section explores the main design considerations for ETSs, and highlights some of the ways they can be used to address the disadvantages of the policy mechanism in the real world.

1.2.1 Point of regulation

An ETS can regulate emissions at three potential points: upstream suppliers or importers of fossil fuels or products containing carbon; downstream emitters of greenhouse gases or the use of products containing embodied greenhouse gas emissions, the most significant of which is electricity. An ETS covering upstream suppliers of energy carriers such as coal or petroleum will typically target fewer sources, resulting in scheme simplicity and reduced administrative costs, but lower liquidity. If the currency of the scheme is the carbon content of fossil fuels, this is very advantageous from a monitoring and enforcement perspective (Fisher *et al.,* 2006). Unless product price controls are implemented, the costs of the scheme are likely to be passed downstream.

Coverage of downstream emitters is the most typical point of regulation in an ETS. This would include electricity generators and on-site power generation by industry, as well as emissions of other greenhouse gases at source (landfill sites, industrial gas emissions). Direct emissions only would be regulated (Scope 1 as classified by the Greenhouse Gas Protocol[1]) to avoid problems of double counting. Downstream emitters have a greater number of abatement options available to them compared to their upstream counterparts, and the coverage of a higher number of emissions sources introduces liquidity into the scheme, all important for the cost efficiency performance of ET.

Product regulation falls into two categories, the regulation of electricity use, and regulation of the carbon content of products at their point of manufacture. The former is far more feasible from the perspective of measurement, the latter is significantly more complex. Regulating electricity use does incentivise both energy efficiency and renewable energy generation at the point of the consumer, and captures these substantial sources of greenhouse gas abatement opportunities. An ETS of this nature may be restricted to sources of Scope 2 emissions above a certain size threshold to reduce administrative complexity.

There is some scope for overlap between these points of regulation, for example, incorporating a product approach (electricity emissions) and downstream approach (direct emissions). Care will need to be taken when dealing with electricity direct emissions as well, to avoid double counting.

Monitoring and administration can be substantial with an ETS, especially in its early year, and therefore a minimum size threshold for participating emissions sources is recommended to reduce the administrative burden on small and medium sized firms. For this reason, consumer based ETS have not typically been favoured.

'Bubbles' are used to increase flexibility for participants. Under bubbles, allocations of allowances are made to a group of emissions sources, and these are then divided between them according to the participant's unique needs. For example, a company can receive a target and allowance for its 'bubble' of emissions sources rather than each source receiving an independent target or allowance. Bubbles allow for entities such as companies or sectors to incorporate their own strategic considerations in response to the regulation. However, the operation of bubbles may exacerbate concerns about market power concentrations (addressed later in this paper).

Price controls on products (not emissions) can prevent emitters from passing ETS costs straight through to consumers, especially in monopoly situations. This mechanism may be important from a distributional perspective.

1.2.2 Use of offsets and hybrid scheme designs

Cap-and-trade schemes can be designed to include credits generated from baseline-and-credit schemes. These credits are also commonly referred to as 'offsets', and lower the cost of compliance for participants as there is a greater supply of credits or allowances (defined to ensure fungibility) within the system. Whilst the environmental performance of the cap-and-trade scheme is lowered through the use of offsets, there may be important environmental benefits outside the cap-and-trade remit as other sectors are incentivised to reduce emissions beyond specific standards. The use of offsets also presents a mechanism for enabling new entrants into the scheme, and to cater for growth in the sector's covered by the cap.

1.2.3 Pilots and the importance of data

The effectiveness of ETSs to meet environmental targets cost effectively, and without unduly restricting growth, lies in the accuracy of the targets and allocations. Overly rigorous targets may force participants to restrict product output or undertake economically premature investments which promotes inefficiency. Targets which are too high would result in a very low price of allowances in the market, and little emissions mitigation. The accuracy of the cost abatement information required to set a cap and allocate targets amongst participants is therefore very important to the success of an ETS. Undertaking a pilot, or a voluntary scheme prior to the implementation of a mandatory scheme may allow the generation of this information and provide comfort to both emitters and the regulators that the scheme prices will be within an acceptable range, and too that an acceptable amount of emissions mitigation is achieved. It is noted, however, that pilots are not guaranteed to reveal this information.

1.2.4 Timeframes

Emission reduction often requires substantial capital investment in new technologies or processes. A stable and predictable policy framework over time is therefore important to create an environment conducive to this investment. For an ETS, certainty of targets and longevity of the scheme is important to enable the market to establish itself. Long lead times for changes in targets or allocation methods are desirable. The ability to bank or borrow credits between compliance periods also adds to participants' flexibility in meeting their targets. Investment can be delayed to be aligned to planned plant upgrades, or until a pending technology reaches the market. The downside of this is that participants may put off making difficult investment decisions until the last minute, increasing the volatility of prices and potentially causing scheme failure. Setting targets which are incrementally tightened according to a pre-set plan will assist in enabling participants to manage their investment optimally.

1.2.5 Target setting

The size of the overall ETS cap will determine the extent of emissions mitigation the scheme will achieve. The cap can be decreased over time in order to realise greater emissions reduction, although mechanisms must be established to enable this. How this cap is allocated between scheme participants will in part determine the distributional aspects of the scheme. There are important acceptability implications of the strength of the cap. A regulator will struggle to achieve acceptance of a scheme if the cap is likely to harm economic growth. A gradual phase-in of a cap may be required in order to secure participant buy-in.

1.2.6 Allocation of allowances and baselines

There are three main methods considered for allowance allocation in an ETS. The first is termed 'grandfathering', and refers to a system where allowances are allocated without charge according to actual historical emissions. A base year (or choice of years) is chosen, and allowances allocated as a percentage of that year's emissions. The choice of year is critical, especially when the base period was at all unusual, or the industry experiences cyclicality. The choice of an inappropriate base year has the potential to prejudice the participant if overly restrictive, or result in windfall gains if they are allocated allowances in excess of current emissions.

Grandfathering suffers from the basic defect that those who polluted most in the past are most rewarded in the allocation of permits and it is inherently very administratively burdensome, requiring a high level of data on the part of the regulator. It is also difficult to make the system flexible to allow for growth or decay of industries. However, grandfathering may be necessary as a way of achieving the acceptability of a scheme by industry. Theoretically, grandfathering should be replaced by an auctioning system as soon as possible after the ETS has been introduced.

The second is allowance auctioning. Here, the pool of available allowances is auctioned by the regulator, and emitters bid for the allowances they believe they will need. Auctioning does not suffer from the perception of 'benefiting the emitter', and has the added benefit of generating government revenue. These revenues could be earmarked for a reduction in other taxes which will benefit business or society, or revenues could be used to offer incentives to encourage the research into and adoption of emission-reducing technologies and processes.

Finally, benchmarking emissions against a sector best practice, and issuing allowances against this best practice level is the final allocation method. A benchmark is established for a sector, and this is then multiplied by an indicator of the installation's level of economic activity (either output or energy consumption). Benchmarking has the advantage of rewarding low-emitters, but has disadvantage of benchmarks being very difficult to establish (Ellerman and Jaskow, 2008). Benchmarking is also a free allocation method, and immediately prejudices new emissions-inefficient participants with no mechanism for adjusting over time.

Under an auctioning allocation mechanism there is a net transfer of income from polluters to the regulator. Polluters experience their mitigation costs in addition to this net transfer. Under benchmarking and grandfathering, wealth is generated within the participants, although they will incur mitigation costs to the extent that the cap is stringent.

An ETS must make provision for new entrants and closures, in order not to compromise sector or economic growth opportunities. There are a number of options for doing this. Allowances can be set aside from the initial cap to allow for new entrants, who can be allocated these according to grandfathering or benchmarking. Alternatively new entrants can be required to bid for allowances under the auctioning allocation method. Offsets may provide a specific 'credit fund' for new entrants. Issues arise as to whether companies can stock allowances to allocate to new company operations. Rules for new entrants and closures need to be carefully designed so as to minimise introducing distortions into the scheme.

Allocation methods can be tweaked to encourage or discourage certain emissions sources, depending on the objectives of the scheme (Johansson, 2005).

1.2.7 Coverage of greenhouse gases and sources

The more emissions sources included in an ETS, the greater the potential liquidity in the market, and therefore the more likely it is that a lower market price and lower emissions mitigation costs will be achieved.

Greater coverage can be achieved by including a greater number of greenhouse gases (as opposed to a scheme which just covers carbon dioxide), a greater number of sectors, or a greater number of regions or countries. However, greater coverage comes with its downside of greater administrative complexity, and the potential that particular long term 'infrastructure' abatement technologies won't be installed timeously because other short term greenhouse gas sources are cheaper to reduce first.

Consideration should be given to the extent of power concentration which exists in the underlying product and emissions markets. According to Fisher *et al.,* (1996: 430):

> In order for a tradable permit system to work effectively, relatively competitive conditions must exist in the permit (and product) markets. The degree of competition will help determine the amount of trading that occurs and the cost savings that will be realised. Should any one firm control a significant share of the total number of permits, its activities may influence permit prices.

Therefore, where monopolistic or oligopolistic market structures are prevalent, the scheme design will need to counter potential strategic actions by participants. Hovi (2006) finds that ET provides more opportunities for corruption than an emissions tax.

1.2.8 Penalties, price floors and ceilings

ET establishes a set quantity of emission reductions, but does not establish the cost of achieving these reductions. This is identified through the market mechanism. This leaves significant uncertainty to emitters, especially when prices are volatile. There are a number of ways of containing cost uncertainty within an acceptable range to enable investment decisions to be made.

Penalties can represent a price, or cost ceiling. If the penalty for not complying with targets is a set fine per allowance short, the emitter can calculate the maximum cost of non-compliance. Direct price ceilings have the same effect: the market price of an allowance is prevented from rising above a maximum amount. Similarly, price floors give participants certainty that if they reduce emissions below their compliance amount, they will receive minimum compensation from the market. Both ceilings and floors are 'market distortions' which reduce the efficiency of the market, but which may be required for the acceptability of the scheme to participants, and for smoothing investment.

Outside of the ETS, price controls can be invoked to protect certain sectors, and reduce the impact of the scheme. Mechanisms to contain competitiveness impacts include: tariffs on traded goods, tax rebates for energy intensive industry, or utilising intensity rather than absolute targets in the scheme.

1.2.9 Implementation and transaction costs

A number of factors influence the extent of inefficient implementation and transaction costs associated with emissions trading, and which represent a deadweight loss to society. Many have been mentioned above, and include: power concentration in the product or emissions markets, and the potential for strategic manipulation, the pre-existing regulatory environment (the more complex and distorted this environment, the greater the costs of ET), and the degree of enforcement required. (Fisher *et al.,* 2006).

Transaction costs can be reduced through access to data, and creating facilities to reduce search costs for participants wishing to transact during the scheme. Liquidity also reduces transaction costs.

1.3 International experience with ETS

ET is a relatively new policy mechanism for the achievement of environmental objectives, developed to address some of the disadvantages of regulation, taxation and subsidies. ET was first explored practically through the trading of rights to emit oxides of sulphur and nitrogen (SOx and NOx) in North America in the early 1990s. Whilst not greenhouse gas schemes, they do provide valuable examples of relatively long-standing schemes. Since then, ET has been applied in a number of countries and regions on both a voluntary and mandatory basis over the past five years, most notably in the European Union which is home to the largest mandatory ETS currently operational, which can be described as the hub of the international market for greenhouse gas emissions credits.

Lessons from international experience are significantly limited due to the short timeframe during which the schemes have been operational. Many have experienced teething problems, and the demonstrated impact on emissions has been typically low. Those in favour of ET and market mechanisms call for patience to enable the benefits of the market to establish themselves, but alternatives such as taxes or regulation are receiving attention due to the urgency of the climate issue.

1.3.1 SOx and NOx ETS in the US

Designed to supersede regulation, SOx and NOx emissions from electricity generating facilities and large industrial boilers across the United States are covered under mandatory cap-and-trade schemes. The analysis in this section is drawn from the largest implementation of the SOx and NOx schemes, the Regional Clean Air Incentives Market (RECLAIM) on the California South Coast, which claims to have the longest history and implementation experience (EPF, 2002).

The initial cap the RECLAIM scheme was set too high, with 40-60 percent excess allowances in the system initially (EPF, 2002). The first seven years of the scheme were therefore characterised by low prices, and little investment in pollution control interventions. However, this changed with an increase in energy demand, causing scarcity of allowances and a corresponding increase in prices. Some believe that industry was lulled into a false sense of security due to the low prices, and failed to plan for future scarcity. Stakeholders to the scheme believe however that the scheme has resulted in lower compliance costs, and has enabled industry to plan switches to a more efficient plant more cost effectively.

Although there is no definitive result on performance of the RECLAIM ETS when compared to a hypothetical regulatory alternative, the EPA analysis suggests that RECLAIM has not performed well in terms of emissions reduction over the eight plus years covered by the analysis. However, other sources indicate that, on a national scale, the SOx and NOx schemes have 'unquestionably and substantially reduced the costs of complying with the Clean Air Act' (Tietenberg as cited in Common *et al.,* 1999).

Another, less positive, finding from a review of the RECLAIM scheme indicates that the potential to earn revenues from the sale of excess credits neither motivated investment in an emissions reduction plant, nor fostered innovation.

1.3.2 The EU Emissions Trading System

The European Union Emissions Trading System (EU ETS) is currently the largest cap-and-trade system in the world, generating 80 percent of the global turnover of allowances and credits (European Commission, 2007). The scheme covers thousands of emissions sources in energy generation and specific energy-intensive industrial sectors including combustion plants, oil refineries, coke ovens, iron and steel plants and factories making cement, glass, lime, bricks, ceramics, pulp and paper (European Commission, 2007). A size threshold on emitting sources is in place to control transaction costs for smaller entities. Discussions are underway around including the aviation industry from 2011 onwards. Only direct (Scope 1) greenhouse gas emissions are covered, with one European Allowance Unit (EUA) representing the right to emit one tCO_2e. Offsets are allowed into the scheme subject to percentage limitations, in the form of credits from the Kyoto Protocol's Clean Development Mechanism (CDM).

The first phase of the scheme, Phase 1 (2005 – 2007) was largely a trial, and included only carbon dioxide emissions. Phase 2 (2008 – 2012) is currently in place and sees the addition of nitrous oxide emissions to the scheme (European Commission, 2007). A Phase 3 is committed for 2013 – 2020.

The cap is allocated amongst member states, who in turn allocate allowances according to their National Allocation Plan, with consideration for their particular economic and political circumstances. In Phase I allowances were allocated to installations free of charge to introduce companies to ET in a gradual way, particularly as the EU was the only region implementing such a system at the time (Point Carbon, 2008). Subsequently there has been a move away from free allocations to auctioning, particularly to prevent windfall gains in the power generating sector (Ellerman and Jaskow, 2008), which has been passing costs downstream, as can be expected in a competitive market (Grubb, 2006). In Phase 1, 95 percent of allowances were allowed to be given to installation for free, in Phase 2 this has been lowered to 90 percent of allowances. In Phase 3 this will drop to 40 percent for the non-power sector and total auctioning of allowances for the power sector. Free allocation will be completely phased out by 2020 save for certain energy-intensive sectors which will continue to get allowances free if they are significantly at risk of greenhouse gas leakage through moving to countries with less stringent climate change laws (European Commission, 2008). Auctioning has been opposed by industry, but strongly supported by governments, market intermediaries and NGOs. Findings from Phase 1 have advocated the setting of a central cap and a move away from national allocation plans which the EU ETS is hoping to implement in Phase 3 (Runge-Metzger, 2008).

Allowances are distributed either through grandfathering or benchmarking procedures. Grandfathering has been the most common method of allocation in Phase I and is still used widely in Phase 2 although more countries are starting to use benchmarking practices, particularly in the power sector (Point Carbon, 2008). The majority of companies prefer the use of three of more benchmarks, so that adjustments can be made for specific situations. Research into the impact of benchmarking as opposed to grandfathering indicates that the two methods can have a significant impact on export exposed industries. For example, the cement industry in the EU is projected to achieve greater mitigation under grandfathering, and an increase in profits, but at the cost of relocation of plant outside the cap-and-trade area (emissions leakage). Benchmarking achieves lower mitigation, but without leakage and loss of productive capacity (Grubb, 2006)

Compliance to the scheme is promoted through financial penalties (€40/t during Phase 1 increasing to €100/t during Phase 2), and a 'name and shame' of non-compliant members.

Concerns over tight scheduling in getting the EU ETS up and running have been raised, and this has been echoed in the preparation for schemes elsewhere, such as the proposed National Carbon Pollution Reduction Scheme in Australia. Interaction between Government bodies and companies during preparation of the First Phase National Allocation Plans was seen to be largely unsatisfactory, and the EC has admitted that any future significant changes will require adequate lead time to prepare for implementation and improved interaction between the stakeholders (EC, 2005). The majority of companies have indicated a preference for allocation periods of ten years plus, with national allocation targets announced two to three years prior to the allocation period in order to provide longer term clarity and stability (EC, 2005). Uncertainty over long-term developments of fundamental rules, particularly allocation procedures, was found to negatively affect the market (EC, 2005)

Phase 1 of the EU ETS has highlighted the benefits of a short pilot phase (Runge-Metzger, 2008). This finding has been taken on board by the Japanese in the use of both the JVETS and the voluntary period which will pre-date the commencement of the new proposed mandatory scheme.

As with the SOx and NOx schemes, the EU ETS suffered from an over allocation in the first phase, with allowances actually exceeding installation emissions. This resulted in a price crash once the first set of compliance data was released onto the market (Runge-Metzger, 2008). This over-allocation has been blamed on a lack of accurate data in advance of target setting (Ellerman and Jaskow, 2008).

Banking has been introduced between scheme phases, after there was a sharp decline in the prices of Phase 1 and Phase 2 EUAs without banking. However, this is not extended to inter-phase borrowing (Ellerman and Jaskow, 2008).

The management of information was critical to the scheme's performance. The sudden and uncontrolled release of emissions data onto the market caused the Phase 1 price crash, and overall it was found that the market benefited by frequent information releases on emissions and allowance utilisation (Ellerman and Jaskow, 2008).

Returning to the issue of pass through of scheme costs downstream by the power generating sector, this was constrained to a degree in countries with less liberalised electricity sectors through regulation or the threat of regulation. However, this is likely to undermine the potential of an ETS to internalise emissions pricing (Grubb, 2006). Export exposed sectors such as cement and aluminium have been found to be at risk of damage to their competitiveness as a result of the EU ETS, should prices rise or their allocations decrease (Grubb, 2006). The prices witnessed before the impact of the global credit crunch result in serious competitiveness concerns which threaten the sustainability of the EU ETS (Grubb, 2006).

Proponents of the EU ETS maintain that the scheme has resulted in an improvement in production process (EC,2007), and that the scheme should allow the EU to achieve its Kyoto Protocol targets at a cost of less than 0.1% of its GDP (EC, 2007). The European Environmental Agency (EUA, 2007) reported a 5% abatement of emissions in the First Phase of the scheme.

The scheme has resulted in the emergence of a new business sector involving market players and financial products (EC, 2007).

1.3.3 The United Kingdom Emissions Trading Scheme

The UK ETS was a voluntary cap and trade ET system operational between 2002 and 2006, which aimed to build capacity in greenhouse gas trading and also to work towards meeting the UK's Kyoto Protocol targets. It was the first cross-industry greenhouse gas ETS to be implemented. The scheme covered all six Kyoto greenhouse gases and included a combination of direct (non power generation) and indirect emissions. The 31 direct participants ranged widely in both size and sector from BP, to supermarkets to the London Natural History Museum. A three year baseline (1998-2000) was used, and an inverse auction conducted where participants bid in emission reduction targets in order to secure a proportion of a GBP215 million incentive pot made available by government.

The UK ETS was linked to companies who were participating in the voluntary Climate Change

Agreements (administered on a sectoral basis, companies received a rebate on their Climate Change Levy by complying with agreed targets). The so-called 'Agreement Participants' could use the UK ETS as a trading vehicle to either meet their targets or sell over-achievement. Finally, the scheme made provision for 'Trading Participants', who were organisations or individuals under no emission reduction obligation that entered the market on a speculative basis.

The UK ETS assisted participants with the discipline of monitoring, reporting and verifying greenhouse gas emissions to the standard necessary for ET, whilst government gained experience in the administration of trading which was subsequently used in designing the EU ETS (DEFRA, 2006). The voluntary nature of the scheme was identified as being important for a pilot, although the ease with which some participants met their targets raised concern. However, emissions reductions achieved through the scheme surpassed expectations (DEFRA, 2006), with substantial over-compliance being achieved by some participants in the cap-and-trade section of the scheme (Smith *et al.,* 2007). As the UK ETS represented a subsidy to polluters to reduce emissions, and was voluntary, it can be argued that participants self-selected on their ability to reduce emissions cost effectively, greatly increasing the cost of the scheme to the government (Smith *et al.,* 2007). Over 50 percent of the sales of emissions were from three large net sellers (direct participants), and Smith et al. (2007) conclude that market concentration and power issues are important when considering the design of ETS.

1.3.4 The New South Wales Greenhouse Gas Reduction Scheme

The New South Wales Greenhouse Gas Reduction Scheme (GGAS), hereafter also referred to as the New South Wales Scheme is an Australian regional baseline and credit scheme which commenced in 2003, built on an existing emissions benchmarking programme which was linked with retailer licensing conditions, and is designed to remain in operation until 2012, with commitments by the NSW Governor to extend targets to 2020.

The scheme is complex in design, involving both mandatory and voluntary participants, and is essentially a baseline-and-credit scheme. Mandatory targets are applied to electricity retail suppliers, electricity customers purchasing directly from the National Electricity Market and certain scheduled generators. Certain large electricity customers of significant state developments can voluntarily elect to participate. Accredited abatement certificate providers undertaking mitigation activities in biological sequestration, electricity or the reduction of direct non-electricity emissions can participate in the baseline-and-credit component of the scheme, selling credits to those with targets. Emissions under this scheme are both direct emissions and indirect Scope 2 emissions.

The scheme cap is based on a limit to per capita emissions from electricity. This cap is progressively decreased from 8.65t/capita in 2003 to 7.27 t/capita in 2007 (a 5 percent decrease), where it is maintained until 2021. Emissions allowances are allocated in proportion to the share of electricity sold or purchased within New South Wales. For example, if a retailer sells 5 percent of the total electricity sales in New South Wales they are obligated to meet 5 percent of the NSW electricity benchmark. The target for NSW as a whole is therefore a 5 percent reduction of emissions below 1989 / 1990 levels by 2012. Accreditation of offset certificates, compliance, regulatory and registry functions are performed by the Independent Pricing and Regulatory Tribunal of New South Wales (IPART).

Participants are able to meet emissions allowance targets through the purchase of Tradable Abatement Certificates (NGACs). NGACs are generated by carbon sequestration, demand-side abatement and energy efficiency offset activities implemented by accredited abatement certificate providers. Some large electricity consumer participants are eligible to claim credits for the reduction of greenhouse gases from industrial processes at sites which they own and control.

Participants can also claim credits for the surrender of Renewable Energy Certificates generated under the Mandatory Renewable Energy Target, itself a baseline-and-credit scheme (MacGill *et al.,* 2003). This is a national target imposed on electricity retailers, who are obligated to purchase a percentage of renewable energy.

Financial penalties of $AUS12/tonne of emissions over target are implemented, with some leeway to make up shortfalls between years. Certificates are bankable with no expiry date. Amendments to the Electricity Supply Act of 1995 and the Electricity Supply (General) Regulation 2002 provide legal means of enforcement.

The mitigation projects within the GGAS generated over 100 million certificates in 2005 (New South Wales Government, 2006). By the end of 2007 there were 204 accredited abatement activities registered, and the supply of abatement certificates as of mid 2008 showed a steady increase (GGAS, 2008). The majority of these certificates (20 percent in 2005) have come from the electricity generation sector (GGAS, 2008).

The assurance of continuation of the scheme independent of the development of a trading scheme at a national level has provided certainty to participants and the market, although the proposals for a national scheme is still proving disruptive. Major amendments to the scheme will be avoided so as not to cause confusion given the establishment of a National Emissions Trading Scheme (New South Wales Government, 2006). Commentators cite the schemes complexity, issues around baselines and fungibility of the very different types of mitigation activities as presenting potential problems to the scheme's performance (MacGill *et al.,* 2003).

1.3.5 The Chicago Climate Exchange

The main cap and trade system in the USA, a country that has not ratified the Kyoto Protocol, is currently the Chicago Climate Exchange (CCX), a regional voluntary scheme which commenced in 2003 and will continue through to 2010. All six greenhouse gases are covered by the scheme and multiple sectors and organisation types are involved including the private sector, NGOs and public sector. Members make a voluntary commitment which is contractually enforceable, to meet annual greenhouse gas reduction targets. The scheme is cap-and-trade in design, but offsets can be used to assist in meeting targets.

Allowances are termed CCX Carbon Financial Instruments (CFIs), and are transacted in contracts, each CFI contract equalling 100 metric tonnes of CO_2e. All the organisation's direct emissions must be included in an annual disclosure which is verified by the Financial Industry Regulatory Authority (FINRA). Indirect emissions are not mandated to be included in the annual disclosure but may be voluntarily reported. CFIs are issued according to an emissions baseline calculated from an average of annual emissions from the years 1998 – 2001. Members commit to reduce emissions by 4 percent by 2006 and 6 percent by 2010.

1.3.6 The Regional Greenhouse Gas Initiative

The first mandatory greenhouse gas ETS in the USA – the Regional Greenhouse Gas Initiative (RGGI) is due to launch in January 2009 with ten North Eastern and Mid-Atlantic member states participating. Direct CO_2 emissions from power plants will be covered, targeting fossil-fuel fired units of 25MW or greater which burn more than 50 percent fossil fuel. Each state will govern its own programme according to a RGGI model rule, with programmes linked through a CO_2 allowance reciprocity which will enable power plants to use CO_2 allowances issued by any of the participating states to achieve compliance.

The emissions cap for the scheme is set at 120 million tonnes CO_2 which approximates current levels. This cap will remain in place for the period 2009 to 2015. After 2015 a decline of 10 percent must occur by 2019. Each state will get an allocation from the total cap and can then allocate 75 percent of these according to its own rules, the remaining 25 percent of allowances must be auctioned with proceeds used for public benefit purposes. In practice the majority of allowances are to be allocated through quarterly auctions. The first auction of credits was held in September 2008, with the allowance price clearing at $3.07.

The use of offset credits is permissible within the RGGI, but will be limited to only 3 percent of the allowances held for compliance and eligible only if the projects are implemented within the US. The scheme deals with price uncertainty through two mechanisms. Firstly, should the allowance price within the system increase to above $7, the percentage of allowances and region of offset projects eligible will change. Secondly, should prices rise to above $10 the compliance period will be extended by one year (up to a maximum of four).

2. Emerging lessons from theory and practice

ET is theoretically more efficient than regulation, and has the significant advantage over other economic instruments (taxes and subsidies) of enabling government to specify a quantitative volume of emissions reductions. In the absence of non-compliance, and bearing in mind the potential for non-additional reductions due to complexities in baseline setting, this should result in a guaranteed volume of emission reductions. However, there is a strong argument in the literature that ET is less efficient than taxes in the reality of high levels of uncertainty and incomplete information (Weitzman as cited in Fisher, 1996; Pizer as cited in Hovi, 2006). Practical experience seems to suggest that the performance of ET schemes is disappointing in reality (EPA, 2002; Runge-Metzger, 2008; MacGill *et al.,* 2003), although proponents of ET would argue that this is due to teething problems, and the short timeframes over which these schemes are being assessed.

The analysis in section one above enables us to summarise some key lessons which have emerged from international experience and theory around scheme design and the implementation process.

- Setting *targets* too low affects the credit market price, inhibits mitigation investment, and reduces confidence in the scheme (RECLAIM SOx and NOx, EU ETS, UK ETS).
- A substantial amount of *data* is required to plan and implement a scheme, and also to maintain the scheme (EU ETS, GGAS). Market and economic information is key to encourage long range planning and decision making, and good communication of this information is important (RECLAIM, 2002; UK ETS)
- Voluntary market creation mechanisms present an alternative to mandatory schemes, and have been used effectively to *pilot* mandatory schemes (UK ETS, CCX, Japanese ETS). Voluntary schemes reduce administrative complexity, since only firms that are likely to have

large enough emissions (or use of inputs directly related to emissions) will sign up. Voluntary schemes are useful for the generation of data. The effectiveness of voluntary schemes in effecting emission reductions is lower than mandatory schemes.

- *Information asymmetry* between industry and government around mitigation opportunities presents a serious barrier to the efficient design of ETS. Negotiations on baselines and target allocations have little chance of resulting in significant additional mitigation action if government does not have similar information to that of industry about the regulated facilities and factors impacting on their decision making (RECLAIM, UK ETS: Smith *et al*., 2007). Auctioning is one mechanism to hedge against this information bias (Grubb, 2006).
- Because of the difficulty of setting targets and baselines correctly, the scheme must allow for *retrospective adjustment* should errors be made (UK ETS, EU ETS), and mechanisms for quick response to unforeseen events effecting the market (RECLAIM). This may be more difficult under an ETS than for other greenhouse gas mitigation policy instruments given the importance of stability for the establishment and operation of the market (Smith *et al.,* 2007).
- This observation extends to the *concentration of market power* within both product and emission markets. Should this concentration be limited to a few key players, their influence in shaping a preferential scheme design at the expense of environmental benefits may be substantial (Smith *et al.*, 2007).
- *Policy stability and certainty* is critical to the effective functioning of an ETS scheme, given a market's reliance on longevity and transparency of targets to price correctly. Any changes in the scheme should be incremental and market as opposed to policy based. Good communication of changes between players is essential (GGAS, RECLAIM SOx and NOx). Most schemes undertaken to date have suffered from policy uncertainty as the international policy environment remains in flux, and necessarily informs domestic initiatives.
- A balance need to be sought between comprehensiveness of coverage of a scheme, and the inefficiency of including very *small players* where transaction costs will outweigh the benefits of their participation. Smaller sources of emissions have different needs to those of larger facilities (EU ETS and RECLAIM).
- Grubb (2006) highlights the balance between an instrument which pursues the objective of influencing long term investment objectives, yet has to manage short term cycles. He concludes that *institutional independence*, and institutions having one primary objective (delivering emission reductions with minimal distortion whilst compensating existing installations for distributional impacts), is vital to achieving this.
- Market-based programmes require significant *planning, preparation and management* both prior to and during the running of the scheme. Stakeholder consultation is very important to develop confidence in the scheme, and minimise the potential for costly errors. Periodic monitoring and revisiting of scheme assumptions is important. (Reclaim 2002; proposed National Australian Trading Scheme).
- Mechanisms such as banking, borrowing, price ceilings or floors and new entrant allocations may be important from an emitter's investment flexibility and efficiency, but do introduce *distortions* into the market itself.
- The methods chosen for *baseline setting and allowance allocation* are very important for distributional considerations, and to prevent over- or under-allocation which would have environmental or competitiveness and economic growth implications respectively.
- Auctioning enables equivalence between taxes and ETS from a *fiscal revenue* perspective. Auction proceeds can be used to protect export-oriented industries for which the adjustment to emissions pricing will be particularly costly, or to reduce the overall tax burden on companies. Whilst economic theory generally disfavours earmarking, this may be necessary to achieve industry buy-in of an auctioning allocation method (Muller, 2008).

3. Application to South Africa

3.1 South Africa's greenhouse gas profile and LTMS target

South Africa's emissions are dominated by energy (around 80 percent) (RSA 2004; Van der Merwe & Scholes 1998), predominantly from electricity generation, transport and direct energy emissions from industry. The remaining emissions are from industrial processes, methane from waste management and agriculture. From a greenhouse gas perspective, carbon dioxide prevails. Apart from electricity emissions, CO_2 emissions are found in the transport sector and from direct emissions in industry (lime production, carbide production, limestone production, on-site energy generation and synfuel's concentrated CO_2). A limited amount of methane is found in the agricultural and waste sectors, arising from the management of manure and enteric fermentation. Coal mine methane forms a sizeable component of industry's non-CO_2 emissions, with a small amount of synfuel methane. N_2O from nitric acid makes up the remainder. South Africa has no significant sources of fluorinated gases (HFC, PCF and SF_6).

From an institutional perspective, just under three quarters of the total emissions are attributable to liquid fuel manufacturing (Sasol, 19%) and the country's electricity supply (Eskom, 53%) (SBT, 2007). An important emissions growth sector is that of transport. Institutionally, transport presents a significant challenge from a mitigation perspective.

The South African cabinet has endorsed a 40 percent reduction from 2003 emissions levels by 2050 (van Schalkwyk, 2008). Due to economic growth assumptions over this timeframe, this implies an emissions peak in 2020/25, a plateau until 2030, and then a decline. The Long Term Mitigation Scenario planning study models a portfolio of mitigation technologies to get the country there. These include a set of negative cost options (with energy efficiency in various sectors dominating, with some renewable, notably solar water heater subsidies), and then those involving positive cost options (predominately renewables, nuclear, carbon capture and storage in electricity generation and electric vehicles).

The LTMS considers three strategic options to mitigation. Two combine a specific suite of technologies: 'Start Now' is driven by energy efficiency, and also enables a significant shift in the fuel mix for electricity supply (27 percent each of renewables and nuclear). 'Scale Up' sets a renewables target at 50 percent, and includes nuclear. The third option models a price on greenhouse gas emissions, and results in mitigation which roughly follows the Required by Science (RBS) trajectory until 2035, when growing emissions from the direct use of coal in industry and petroleum products in transport outweigh the reductions from the greenhouse gas price. The greenhouse gas pricing option (titled 'Use the Market'), assumes an escalating greenhouse gas price, from R100t/CO_2e now to R750t/CO_2e in 2050. The final option comprises a set of unknown technologies, and is identified as 'Reach for the goal', enabling the country to follow the RBS trajectory.

It has been assumed that the first two scenarios make use of regulatory policy mechanisms, in contrast to 'Use the market' which makes use of an economic instrument. Whilst the economic instrument appears from the high level LTMS analysis to facilitate the greatest volume of greenhouse gas emissions mitigation over the timeframe, the study did not explore what type (or types) of economic instrument would be most appropriate or feasible. The various strategic options are also mutually exclusive in their design (although the mitigation technologies employed overlap), and all are considered to begin in year 0 and run the full timeframe until 2050. The options only diverge significantly in mitigation performance from around year four, indicating some flexibility in the design of policy instruments to enable the required mitigation.

3.2 Economic, institutional and political considerations

South Africa's economic drivers and mitigation profile are inextricably linked. The country's electricity price has historically been one of the cheapest in the world, resulting in a culture of energy abundance and low attention to energy efficiency. The economy has therefore developed an historical competitive advantage around cheap electricity, led by Eskom, the national utility which effectively generates and transmits the entire country's electricity supply, and a large portion of that of the Southern African sub-continent. In January 2007 this nirvana came to an abrupt halt as Eskom ran out of power as a result of underinvestment in generation capacity. The country now faces a critical shortage of electricity supply which is anticipated to continue until at least 2013. In the aftermath of this crisis, there has been a sudden focus on energy security, conservation and efficiency.

Following international best practice, government embarked on a programme of privatisation of the electricity sector in the late 1990s and early years of this century. This programme has been almost entirely ineffective and has now been sidelined by the electricity crisis. However, elements of it have been retained; most significantly for the purposes of this paper, the requirement that 30 percent of generation must come from independent power producers, although Eskom remains the sole purchaser of electricity.

A number of interventions are being pursued in the electricity sector as a result of the crisis, under the heading of the Power Conservation Programme (PCP) which Eskom has been tasked to develop. Whilst it is beyond the scope of this paper to explore the PCP in detail, developments in this area are critical to the consideration of policy instruments for greenhouse gas mitigation, given that Eskom represents over half of South Africa's emissions. Also, many of the negative cost mitigation options identified under the LTMS are in the area of electricity generation (renewable and nuclear) conservation, efficiency and reduction of future demand (e.g. solar water heaters). From a political perspective, the urgency of the crisis response presents a unique opportunity to align mitigation objectives with those of security of energy supply, and ride on the attention this significant area is currently receiving. In this, there is also a threat that the response will favour short-term remedies, which are typically less costly and more emissions intensive.

The PCP is aimed at achieving a 10 percent reduction in electricity demand, whilst maintaining the 4% economic growth objectives contained in government's Accelerated Shared Growth Initiative for South Africa. The PCP comprises a number of initiatives, one of the cornerstones being the Energy Conservation Scheme which requires mandatory electricity reductions through a quota system. It is being proposed that this quota scheme is supported by a trading aspect, the Right to Consume scheme (Eskom, 2008).

Additional policy developments in the electricity sector include the Renewable Energy Feed in Tariff which will subsidise renewable energy power generators (this initiative is being implemented by the National Energy Regulator). A green certificate trading scheme is being developed by the Department of Minerals and Energy, aimed at further assisting renewable energy generators. The Treasury has proposed a tax on fossil fuel-generated electricity of 2c/KWh in the finance minister's 2008 Budget Speech, although this has subsequently been put on hold and may be aligned with additional greenhouse gas emissions taxation. In the 2009 Budget, the Minister has indicated tax relief for energy efficiency investments, an increase in the fuel tax, increased taxation on high-emission imported vehicles, and a tax on energy-inefficient lighting, all of which have greenhouse gas mitigation components.

The current political priorities of the country are focused strongly on the dual objectives of employment creation and poverty alleviation. Exploiting synergies between greenhouse gas mitigation and these broader policy considerations may provide important leverage for the earlier inclusion of mitigation policy than might otherwise occur, as economic growth also remains a priority, and the government has to work within its (tightening) budgetary and capacity constraints.

In the light of the international credit crisis and objectives of employment creation and poverty alleviation, South Africa has announced substantial infrastructure investment programmes. As many of these programmes will determine the country's greenhouse gas profile for decades to come, consideration of these programmes and expenditure in the light of the LTMS trajectory and pace and emphasis of greenhouse gas mitigation policy is crucial.

South Africa is classified as a developing country in the Kyoto Protocol, yet is also identified as one of a set of rapidly industrialising countries (along with China, India and Brazil) which are being earmarked for some form of commitment to emissions reduction in the medium term. Until such a time where there is an internationally enforced price for greenhouse gas emissions, South Africa will have to balance the competitiveness implications of domestic greenhouse gas mitigation policies with its own commitment to a mitigation trajectory (Johansson, 2005), and creation of competitive advantages in an emissions-constrained future global economy.

3.3 Greenhouse gas mitigation policy in South Africa

The focus of this paper is consideration in greater detail whether ET is appropriate for South African conditions, and how it could be designed to account for particular characteristics of the economy. From the analysis of ET considerations and lessons in section two, and against the backdrop of South Africa's emissions profile and political, economic and institutional environment, a number of these lessons stand out as being of particular relevance for the country.

3.3.1 Capacity to implement an ETS

ETS are experienced as requiring a high level of data on behalf of the regulator, extensive planning and design, and active and responsive maintenance and ongoing development. South Africa is a developing country, and experiencing a skills constraint, particularly in the public sector. The country does not have experience of greenhouse gas mitigation, nor extensive experience of market mechanisms, particularly in the electricity sector.

The greater the uncertainty and lack of information, the more complex an ETS is likely to be in its design, in order to ensure against the abuse of market power and negative distributional consequences. Complexity requires capacity to implement.

That ET is a sophisticated economic instrument, not uniformly well understood, and suffering from negative perceptions relating to potential polluter gains, building confidence in the scheme from the start will be an important objective. Administrative and capacity needs should be carefully and critically assessed, and provision made for the strategic creation of these within an appropriate institution.

That South Africa's energy sector has greater characteristics of central planning than liberalisation may suggest that the use of a market mechanism to mitigate greenhouse gases will be challenging. However, theory also suggests that should the underlying sector be moving towards a market-oriented approach, a market mechanism could facilitate this (Fisher *et al.,* 2006).

3.3.2 Emissions coverage – energy focus

An ET can encompass all six Kyoto gases, or a subset of these. Given the comments on capacity above, and the limited and specific incidence of non-CO_2 gases in South Africa's emissions profile, targeting of CO_2 only may be appropriate. This will limit the requirements for understanding mitigation options to energy and direct CO_2 emissions, and will reduce the potential for market price distortions from cheap mitigation options from the remaining gases.

This focus could possibly be further refined to justify the energy component of CO_2 emissions.

This approach would again reduce complexity, whilst still addressing 80 percent of South Africa's greenhouse gas profile. It is aligned to the current attention the energy sector is receiving as a result of the energy crisis, and captures many of the negative cost mitigation options modelled in the LTMS, increasing the likelihood that the financial burden of the scheme would begin modestly

This line of argument leads to the integration of an ETS with policies being pursued under the PCP. This is further addressed in the paper on White Certificates in this series, but the RTC scheme may provide an existing vehicle which could be expanded to include additional, non-energy efficiency sources of greenhouse gas mitigation in the future. Lessons from the New South Wales scheme which contains both direct and indirect energy emissions should be explored further in this regard.

A downside of the focus of an ETS on the energy sector and the CO_2 only approach is that certain key and long-term investments, particularly in infrastructure which will determine the country's medium-to-long-term carbon profile (e.g. power generation, transport infrastructure, new build coal-to-liquids plants) may not receive the required incentive necessary to ensure the greenhouse gas implications of this investment are taken into account, given the timing of these investments and an anticipated low credit price in the early years of the scheme. Additional policy measures such as subsidies may be required to support this.

In order to contain the competitiveness impact of an energy sector ETS for energy-intensive export-oriented industry, mechanisms such as tariffs on imports or tax rebates at the point of export could be considered. Alternatively, favourable allocation methods may be used to protect certain sectors, or some sectors might be included through intensity targets.

The regulation of the transport sector presents a significant challenge from an institutional perspective. Nowhere has an ETS been applied to this sector, and great consideration would need to be given to the incorporation of this sector into an ETS.

3.3.3 Point of regulation

Power concentrations in both the emissions and product markets are both theoretically and practically highlighted as sources of scheme underperformance and failure. Almost three quarters of South Africa's greenhouse gas emissions is from two companies, Sasol and the electricity utility, Eskom. This is critical when considering where the point of regulation occurs in a proposed ETS. Regulation of downstream emissions (i.e. at the point of combustion of fossil fuels) may not prove appropriate from this perspective, even if allocations are made at an installation level. Under such a design, price controls may be required to prevent the full cost of the scheme being passed directly to the consumer, with potentially negative distributional and competitiveness consequences.

Other options include regulation of upstream fuel providers (coal, oil and natural gas). Again, the limited number of these entities and the structure of the energy sector and markets may render this approach similarly inappropriate.

In order to achieve the required liquidity and avoid market concentration issues, a combination of a 'product' (electricity) and direct emissions (excluding power generation) might provide the optimum mix. This points again to the interaction between such a scheme and the proposed RTC scheme under the PCP.

3.3.4 Timing: Importance of long lead times

Experience shows that long lead times to allow for adequate preparation and scheme design, as well as to send strong signals to emitters to plan for compliance and particularly investment in mitigation activities are important to prevent disruptive and confidence damaging retrospective adjustments, and to facilitate least cost compliance. Consultation with participants is also important, and long lead times allows for both a greater understanding of possible mitigation activities and decision making processes of emitters, as well as the collection of data necessary for accurate target setting.

Particularly given the developments underway targeting energy conservation and efficiency in the electricity sector, a considered and lengthy planning of either an extension to an existing mechanism such as the RTC scheme or the establishment of an ETS will strengthen the scheme's chances of performing well.

A voluntary pilot may be used to precede an ETS, facilitating price discovery and enabling learning about the operation of an ETS domestically.

3.3.5 Data and mitigation costs

There is very little existing data on the costs of mitigation, and indeed on certain emissions levels within the South African inventory. Information, and particularly symmetry of data on behalf of both the regulator and emitters has emerged as being very important to ensure that appropriate targets are met, that costs do not unduly inhibit growth, and that windfall profits for certain participants are avoided.

In South Africa, it is not clear that sufficient data and information exists on the costs of mitigation. A certain level of information has been agreed under the LTMS, but this is relatively high level and aggregated. Work is underway to understand sectoral mitigation opportunities and costs in greater detail (see the forthcoming FRIDGE 'Study to provide an overview of the use of economic instruments and to develop sectoral plans to mitigate the effects of climate change)'. It would appear therefore that there is a concern around data and mitigation costs, and that this aligns well with the point above on lead times. Longer lead times would allow time for better understanding of emissions mitigation opportunities and costs (Fisher *et al.,* 1996).

3.3.6 Allocation method

Experience and theory indicate that free allocation on a grandfathering or benchmarking basis is likely to be a necessary starting point for allocations in an ETS. However, it is important to move to an auctioning basis as soon as possible. This might be aligned to the transition between a voluntary pilot and mandatory phase of an ETS.

3.3.7 Importance of certainty

Policy uncertainty and change emerges from theoretical and practical experience as being particularly damaging for an ETS scheme. At the time of writing, both the international and the domestic mitigation policy environments are particularly unclear. Internationally, the Conference of the Parties to the Kyoto Protocol in Copenhagen at the end of 2009 is widely expected to provide some clearer indication of post-2012 international climate change policy frameworks. Locally, there are numerous policy initiatives under development which are in some way related to climate change mitigation, particularly in the energy sector. The Department of Environmental Affairs and Tourism is leading an initiative to develop a more co-ordinated and consolidated approach to climate change mitigation, with a National Climate Change Summit that was planned for March 2009 to further this objective.

Particularly in the electricity market, many distortions currently exist, particularly with regard to the sudden and steep tariff increases. The more distortions, the less efficient a greenhouse gas market policy mechanism will be, and the more complex its design.

From a timing perspective, the advantages of waiting before implementing climate change mitigation policy, and particularly that of a market mechanism, far outweigh a hurried approach which might result in an inappropriately designed and consulted scheme. This is particularly so because many of the negative cost mitigation options are being considered under the electricity crisis response.

Certainty is important from another perspective, that of certainty of prices within a proposed ETS. Whilst a market mechanism does not provide this by the nature of the way in which it works, there are ways of incorporating an element of certainty, such as through price floors and ceilings. Without these, the market is not guaranteed to send the right investment signals in the short term. It may then be advantageous to include some price certainty especially in the early years of the scheme. Getting this price right is critical, and will require information and research.

4. Conclusion and future work

The application of theoretical and practical lessons from ETS to the South African situation result in a number of recommendations on the feasibility and design of a domestic greenhouse gas ETS for the country:

- Any ETS would benefit from a long planning and consultative lead time in order to generate data on which to base targets and allocations; to communicate targets to emitters and give them time to plan investment activities; and to allow for international and domestic policy stability. This coincides with both the LTMS trajectory (peaking in 2020 / 25) and the immediate focus on energy security, efficiency and conservation.
- There are strong reasons for considering aligning a future ETS to current policy initiatives in the electricity sector. Particularly interesting in this regard is the development of the RTC trading scheme under the PCP.
- The transport sector presents a significant challenge from an ETS perspective. It is recommended that, due to capacity constraints, this sector may be considered for incorporation in a second phase, or addressed through alternative mitigation policy instruments.
- As certain long term infrastructure and investment decisions critical to South Africa's ability to meet its long term LTMS target, will and are being made in the short term, these need to be addressed either through communication of the intention of allocating targets under an ETS in the future, or by some alternative policy mechanism.

This paper is an initial study of ET, and its application to South Africa as a domestic emissions mitigation policy instrument. Whilst broad findings emerge from the guidance of theory and lessons from existing ETS implemented internationally, more research is required to confirm these findings and to explore them and others more comprehensively. The following have been identified as future research areas:

- The design of an ETS incorporating both direct and indirect electricity generation emissions, with particular reference to the New South Wales scheme (GGAS).
- How a domestic South African ETS might link in with international trading schemes, and what the implications of this are for scheme design.
- A detailed exploration of how a domestic trading scheme might be supported by other mitigation policy instruments.
- Consideration of the size of emissions sources

which would be regulated under the scheme: what represents an efficient threshold in the South African context?
- Study of how a white certificate trading scheme such as the proposed RTC scheme might be expanded to include additional sources of emissions, both energy related and other.
- A field trip based study to understand the process of design of some of the existing ETS in existence internationally, and to identify what techniques have been used to analyse or model projected price realisation and volatility, implications of the inclusion of various emissions sources and sectors, and other design elements.
- Undertake a comparative analysis between tax and ETS as economic instruments for achieving a greenhouse gas price in South Africa.

Note

1. The GHG Protocol defines emissions as follows: Direct emissions (Scope 1) are those emissions from sources owned or controlled by an organisation e.g. emissions from a power plant, business travel in a company car. Indirect emissions are those occurring from sources owned or controlled by another organisation but resulting from your activity. Purchased electricity, steam or heat falls under Scope 2, all other indirect emissions e.g. business travel, production, outsourced activities e.g. printing and courier services fall under Scope 3. (www.ghgprotocol.org accessed 10 February 2009)

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