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GROWTH AND EQUITY (FRIDGE)

STUDY TO PROVIDE AN OVERVIEW OF THE USE OF ECONOMIC INSTRUMENTS AND DEVELOP SECTORAL PLANS TO MITIGATE THE EFFECTS OF CLIMATE CHANGE

Executive Summary

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Genesis Analytics (Pty) Ltd

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EXECUTIVE SUMMARY

INTRODUCTION

This report investigates the viability of using economic instruments to mitigate greenhouse gas (GHG) emissions in South Africa. The aim of this report is to gain a better understanding of the actual policy mechanisms which are available to achieve emission reductions, and their potential impacts on different South African sectors within the context of South Africa's industrial policy framework. The findings of the study will contribute to the national discourse around GHG emission reduction regulation, and empower industry to engage with government constructively to develop the most efficient and effective policy mechanisms to move South Africa to a low-carbon economy in the long term. In addition, the project will highlight what abatement options are available to individual sectors. This Executive Summary presents a summary of the key findings and recommendations to emerge from the research.

AVAILABLE EMISSIONS REDUCTION POLICY INSTRUMENTS

Market failure due to the negative externalities arising from greenhouse gas emissions provides the rationale for policy interventions to move the economy to a socially optimal level of emissions, where the cost of damage is exactly equal to the cost of abatement.

Instrument category	Instrument name	Description	Mechanism to reduce emissions
Regulation	Performance standard	Regulator sets some kind of target for the level of emissions that producers must comply with or face penalties	Quantity
	Technology standards	Regulator determines minimum technological standards that producers must comply with or face penalties	Technology
	Information disclosure	Labelling requirements inform consumers about the carbon content of goods. This may lead to substitution towards less carbon-intensive goods.	Quantity/ Price
Using markets	Taxes	A tax is set on emissions to force producers to internalise the full cost of their activities	Price
	Subsidies	Incentives are provided to subsidise the cost to producers of reducing emissions or to encourage R&D in climate-friendly technologies. Subsidies can include public or private funding provided to science councils, universities etc to advance research focused on GHG mitigation.	Price
Creating markets	Cap and trade schemes	A certain cap on emissions quantities is determined and producers then face a decision to reduce emissions internally to meet the cap, or purchase emission reduction permits from those able to beat their caps more cost effectively.	Quantity
Voluntary	Voluntary commitments	Mitigation activities voluntarily agreed to by producers. Often used in the early stages of environmental policy consideration to aid adaptation before more stringent measures are introduced. Can include government-led initiatives such as consumer awareness campaigns.	Quantity/ Technology/ Price

GHG mitigation instruments
Source: Genesis Analytics, 2010

The table above outlines the various policy instrument options available to address this market failure. Internationally there is a move towards market based mechanisms to provide the central instrument in a suite of climate policy interventions. Whilst from an economic theory perspective market instruments are more efficient than their regulatory counterparts, ultimately the particular country and sector context will determine the most appropriate instrument to use.

CRITERIA FOR INSTRUMENT CHOICE AND DESIGN

A number of considerations are pertinent when designing a climate mitigation policy suite, and should determine whether and which instruments suite a specific context.

E**nvironmental effectiveness** refers to the ability to achieve reduced emissions. **Economic efficiency** means that an instrument encourages of 'least-cost abatement' over the short and long term. Instruments which encourage **substitution** by consumers to lower-carbon products and processes increase efficiency. Maintaining and creating **competitiveness** in a global economy transitioning to a low carbon future is crucial for maintaining growth. The **administrative requirement** related to the implementation of mitigation instruments affect the cost of using the instrument, as does the **data and information** required to **successfully implement an instrument. Distributional effects** are another particularly pertinent consideration for developing countries, as is **fiscal affordability** of the overall policy suite. **Buy in and support** for the instrument is important to avoid resistance. Climate change policy instruments must be **compatible with the broader policy environment** to ensure policy coherence. Finally, there must be **flexibility** within the policy suite to allow firms to adjust to the fluctuations of the economic cycle.

The criteria mentioned in the previous paragraph is not applied to the availably policy options to evaluate their attractiveness within a larger suite of policy options.

Regulatory options

Regulatory options to emissions reductions are arguably the most straightforward mitigation options. Theory shows regulatory instruments generate a less efficient outcome and generally market-based interventions are proving more attractive to policymakers internationally. Nevertheless regulation may have a place as part of a larger suite of policy options.

- *Performance standards* are environmentally effective and administratively simpler than other instruments. However, unless the government has a high level of information about individual firms and abatement technologies, performance standards are not economically efficient, and are therefore unsuitable as a mainstay of an economy's mitigation policy suite. They may be useful where there are few emissions sources (or many homogenous sources) and a high degree of information exists around these.
- *Technology standards* are also economically inefficient, and do not have the environmental effectiveness advantage of performance standards. However, they can be effective in achieving large reductions quickly where a low cost substitute technology exists but has not been widely adopted for reasons of market failure.
- *Information disclosure* rules are fiscally affordable and encourage substitution, but the level of environmental efficiency depends on consumer preferences.

Using markets

The advantage of **market based policy instruments (**is that they are economically efficient, and require less information than regulation; government need only understand the abatement cost curve for the country or industry as a whole, not for each individual firm.

- *Taxes* additionally provide flexibility in that firms can choose whether to abate or pay the tax in each year. However, taxes are not as environmentally effective as quantity based instruments, as they target emissions indirectly through the price mechanism. A lack of data around mitigation costs at a sector level will lead to uncertainty over the level of mitigation which occurs. Taxes also tend to be unpopular. They can also become regressive over time, if measures are not put in place to counteract this. A significant advantage of a tax is that it generates fiscal revenue, which could be recycled to strengthen progressivity, ensure revenue neutrality, or further incentivise emission reductions.
- *Subsidies* can be economically efficient in the short term, and are popular with the private sector. However, their drawbacks are that they impose a cost to the fiscus, and that in the medium to long term they are not environmentally efficient as there are likely to be more entrants to polluting sectors (or prevent firms from exiting the market).

Creating new markets

The creation of new markets can capture both the environmental efficiency of a quantity instrument and the economic efficiency of a price instrument. *Cap and trade* will achieve a specified emission reduction volume, but depending on government's information around abatement costs, the price in the market is uncertain. Additionally, it may be highly volatile for reasons including timing, lumpy investment profiles, and future policy uncertainty. Depending on the allocation mechanism for initial allowances, the mechanism can generate fiscal revenue which is equivalent to that of a tax. This is however unlikely in the initial years of the scheme. Cap and trade schemes include significant complexity in the design and establishment of the scheme. Transaction costs are also high. Liquidity of the scheme is important to realise the mechanism's benefits, and market concentrations can be problematic. Cap and trade does enable participants to make use of sophisticated risk management mechanisms to smooth their transition to a low carbon economy.

Voluntary mechanisms

Voluntary mechanisms can utilise any of the instrument types discussed above, but are voluntary in nature. Whilst being useful for generating data, preparing industry for mandatory measures and overcoming resistance, these instruments tend to be ineffective at any serious level of mitigation.

THE SOUTH AFRICAN CONTEXT

Greenhouse gas emissions structures

79% of the country's emissions profile is made up of emissions associated with energy, with the remainder being industry process emissions, and methane from waste management and agriculture. The high contribution of energy is largely due to the country's reliance on coal for

electricity generation. From an institutional perspective, two organisations dominate South Africa's GHG emissions, accounting for 56% of total emissions (Eskom 44% and Saso 12%).

The structure of the electricity generation market (Eskom is a state-owned monopoly) and the prominence of developmental goals have combined to keep the price of electricity artificially low historically. This has caused a number of problems from both a climate change and growth perspective, not least the decreased incentive for investment in new power generation capacity which resulted in the recent capacity shortfall experienced by Eskom. Cheap electricity also meant that industrial, commercial and household users of electricity have had little incentive to use it efficiently or to invest in more efficient alternatives. Inexpensive electricity has historically been instrumental in attracting energy-intensive firms to South Africa, and large capital investments then caused the economy to become "locked-in" to a pattern of high energy consumption.

Energy Sector Policy Implementation

The implementation of energy policy to address this situation is currently highly fluid and uncoordinated, with no clarity on a long term plan in place or under development. A number of initiatives aligned with Cabinet's climate vision are under development, but these remain stalled by the lack of a long term co-ordinated approach. For the time being, it seems likely that the main emphasis will remain on coal-fired electricity generation. Substantial increases in the price of electricity are expected over the next few years as the price is aligned with the real cost of generation, provided that the National Energy Regulator of South Africa (NERSA) allows electricity prices to rise to cost-reflective levels. This should act as a natural stimulus for the adoption of more efficient practices and technologies. Increasing the cost of electricity so that it reflects the full cost of production is important in order to reduce the distortion in the electricity market as well as to incentivise energy efficiency.

Current developments in the South African electricity market introduce a complex and potentially contradictory range of incentives into the energy economy. In this context, current climate mitigation policy instruments such as the REFIT and an electricity carbon tax could possibly be ineffective or even act as incentives for emissions intensive behaviour. It is imperative that any climate change policy suite act as a stimulus for policy co-ordination within the energy sector. Climate change policy should also be designed to align with current (and proposed) energy policy instruments aimed at conserving electricity use and encouraging renewable and nuclear energy uptake.

Modelling the Peak, Plateau and Decline Trajectory

Cabinet's Peak, Plateau and Decline trajectory is based on the modelling undertaken in the Long Term Mitigation Scenario (LTMS) process. Four scenarios were modelled, none of which go far enough to align with the Cabinet's trajectory in the long term. It appears that aggressive energy efficiency will be sufficient to meet the Peak (aligned with the 2020 34% reduction form baseline emissions offered at Copenhagen), but substantial progress will need to be made in laying the groundwork for the reductions from the remaining technologies modelled in the LTMS (renewables, nuclear, electric cars, passenger modal shift, carbon capture and storage etc) and more, post 2020. The 'Use the Market' scenario in the LTMS, modelling the imposition of an escalating carbon price comes closest to the medium and long term ambitions of Peak, Plateau and Decline, seeming to indicate that a price mechanism is likely to provide the heart of the long term mitigation policy suite. This is aligned to international climate mitigation policy thinking and direction. The government has shown commitment to Cabinet's mitigation policy

vision, but faces a number of other policy challenges. South Africa is still a developing country with high levels of poverty and unemployment, so any climate policies must be incorporate the need to grow the economy, create jobs and limit the impact of policies on the poor.

CLIMATE CHANGE, INDUSTRIAL POLICY AND INDUSTRIAL COMPETITIVENESS

The impact of climate change policies on industrial competitiveness is ambiguous. While climate change creates many opportunities for firms through the development of new markets for low-carbon environmental goods and services and increased efficiencies as a result auditing their production processes, there is a concern that having to internalise the cost of GHG emissions may reduce the international competitiveness of sectors. The impact of climate change policies have to date been relatively small and dwarfed by factors like trade barriers and transport costs. The reason for this is that carbon leakage effects have been largely offset by technology spillovers. The cost impacts of climate change policies, however, vary widely between sectors, and that there are usually a minority of sectors (typically upstream sub-sectors using energy and GHG-intensive processes to produce low value-added products) that are significantly affected. The socio-economic challenges that face South Africa mean that climate change mitigation needs to be balanced with the need for sustained economic growth In the long term this report finds that climate change policies will support the stated industrial policy objective of diversifying the South African economy away from its current over-reliance on energy- and capital-intensive upstream resource-based manufacturing, and sectors that are no longer viable in South Africa in a carbon-constrained world should thus be allowed to migrate to other parts of the world. In the short to medium term, however, vulnerable sectors should receive support to move towards a more environmentally sustainable growth path built around higher value-added and knowledge-based production and production processes that produce fewer GHG emissions.

CLIMATE POLICY IN SOUTH AFRICA: POLICY POINTERS

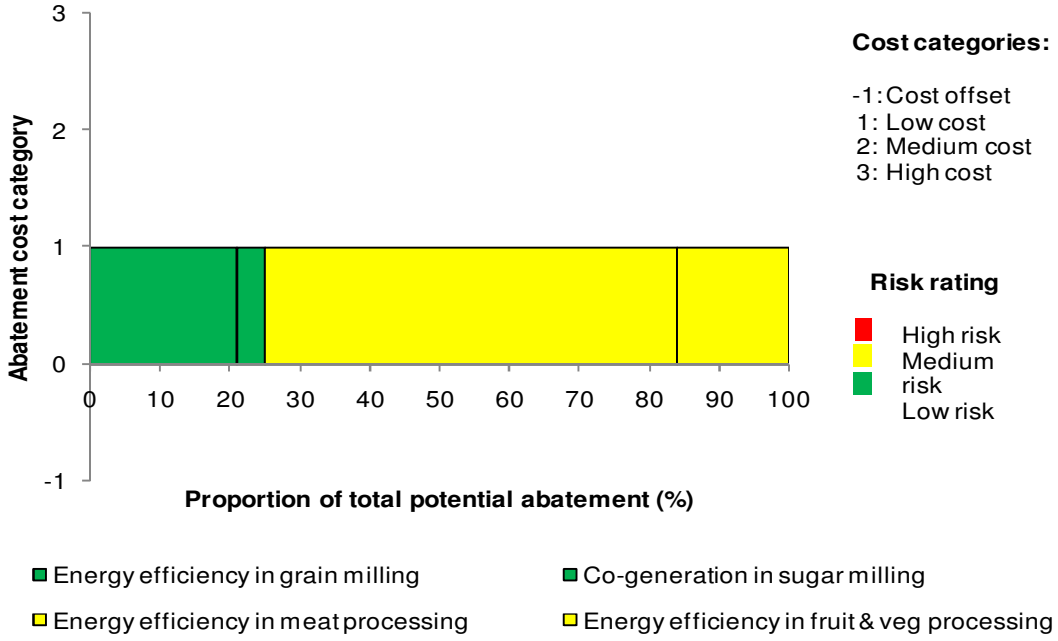
Best practice guidelines identified for climate change mitigation policy include: Taking a *strategic and holistic approach* to climate mitigation policy, and ensuring *coherence* with other policy areas. *Transparency* is vital to building consensus for the policy instruments chosen. *Long, loud and legal* policies provide the private sector with certainty for planning. *Implement policy slowly, but do it right* to avoid costly reviews and changes which introduce uncertainty.

SECTOR CASE STUDIES

Severe data limitations make it impossible to create accurate standard abatement cost curves in South Africa at present. *An innovative methodology was developed* to overcome this limitation and *to provide the maximum insight regarding cost, riskiness and abatement potential of available emissions reduction options in a number of focus sectors*. The methodology employs a case study approach based on the use of “indicative abatement cost curves” (IACCs) constructed with the strongest available data for each abatement option in each sector to highlight the attractiveness of the main emissions reduction options open to each focus sector (see section **Error! Reference source not found.** and section **Error! Reference source not found.** for details of the methodology). It must be noted, however, that **the current approach serves as an information tool only**. Much more detailed cost and emissions data

(which do not currently exist in South Africa) is needed before it can serve as the basis for policy formulation (see section **Error! Reference source not found.**).

Agro-processing



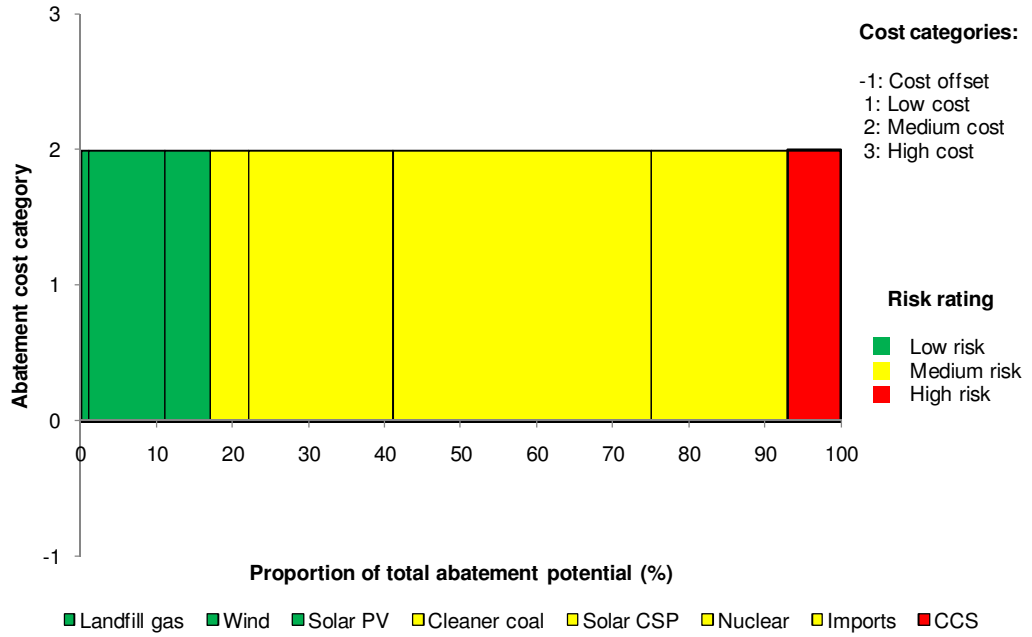
IACC: Agro-processing
Source: Genesis Analytics, 2010

The Agro-processing case study suggested that climate change is not currently considered a business imperative in this sector. A considerable amount of effort is thus recommended to raise awareness of climate change issues and the particular risks and opportunities it poses for the food industry. In order to develop and implement an awareness programme, research is required to determine quantitative estimates of energy use and GHG emissions. Only five significant mitigation options were identified in this sector. One of these factors, namely solar cooling in the fruit industry, was not included in the IACC because of the lack of available quantitative estimates relating to its attractiveness. The lack of availability of data illustrates that a review of GHG emissions on a sector-wide and sub-sector-wide basis is an imperative for the Agro-processing sector to meaningfully engage in any debate on GHG mitigation and to provide input into the development of GHG mitigation strategies. In summary no significant action can be taken by the food industry unless clarity is obtained on what baseline GHG emissions are. Based on the cost and risk ratings of available mitigation options in the Agro-processing industry, the *attractiveness of available mitigation options was ranked as "average"*.

Electricity generation and supply

The electricity supply sector is currently dominated by a single utility. Although Eskom is already undertaking various activities in exploring renewable energy, the utility is faced with an imperative to build new base load supply to meet the growing demand in the country. Meeting

this growing demand, at least in the medium term, will be done through building new coal fired power stations. It is likely that IGCC (a "cleaner" coal technology) will eventually be used in South Africa, although the next power stations to be built will use supercritical coal technology. Given the dominance of energy emissions in South Africa's total emission there is a need for ongoing and increased efforts in building renewable energy capacity, in addition to using cleaner coal technologies. Research is required into the most efficient ways of exploiting renewable energy. The electricity supply case study suggested wind, nuclear and solar CSP as the most promising technologies (with medium abatement and low to medium implementation risks, and the potential to contribute 20% or more to the sector's overall greenhouse mitigation). It is noted that in order to ensure grid stability, a range of responses is required; no single technology presents an overall solution for the sector.



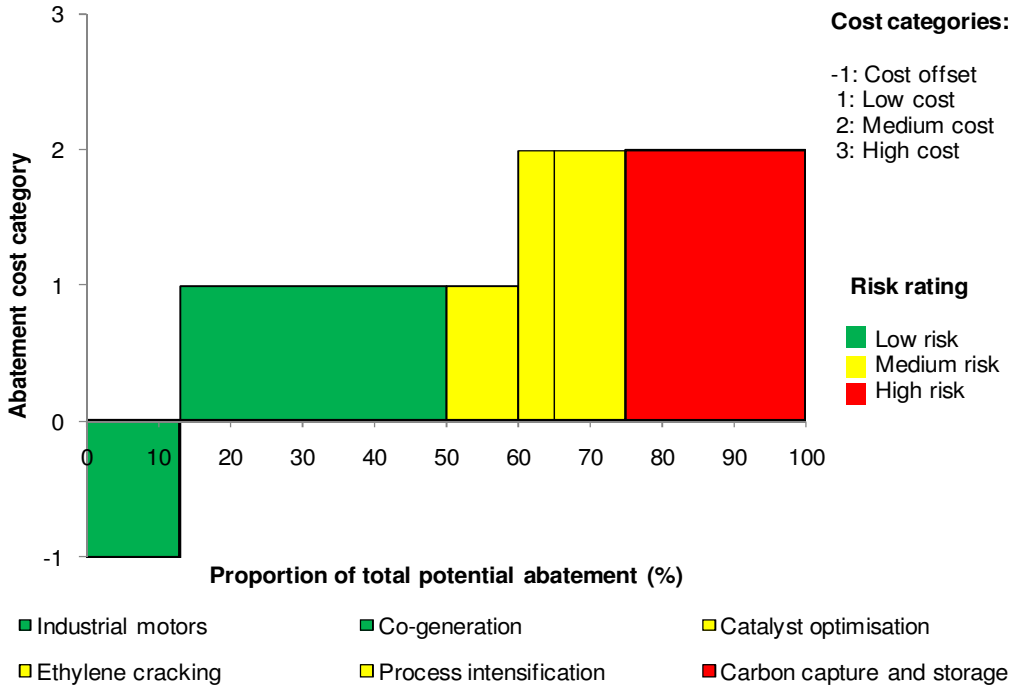
Electricity generation and supply
Source: Genesis Analytics, 2010

Based on the cost and risk ratings of available mitigation options in the sector, the *attractiveness of available mitigation options was ranked as "poor"*.

Chemicals

There is a lack of reliable GHG emissions data for the Chemicals sector. According to the LTMS the production of nitric acid, carbide and ammonia generate the bulk of chemical sector emissions. The development of a chemical sector GHG emissions inventory should thus initially focus on the production of these chemicals. However, it is possible that there are other processes that are major sources of GHG emissions. Electricity constitutes a significant proportion of the chemical industry's overall energy spend. Energy efficient technologies are thus likely to become a significant source of competitive advantage in this sector. Significant revenue growth for specialty chemical firms may also be derived from the development and

marketing of chemical products which help to reduce energy consumption as well as materials for new energy technology (e.g. solar photovoltaic cells and fuel cells).

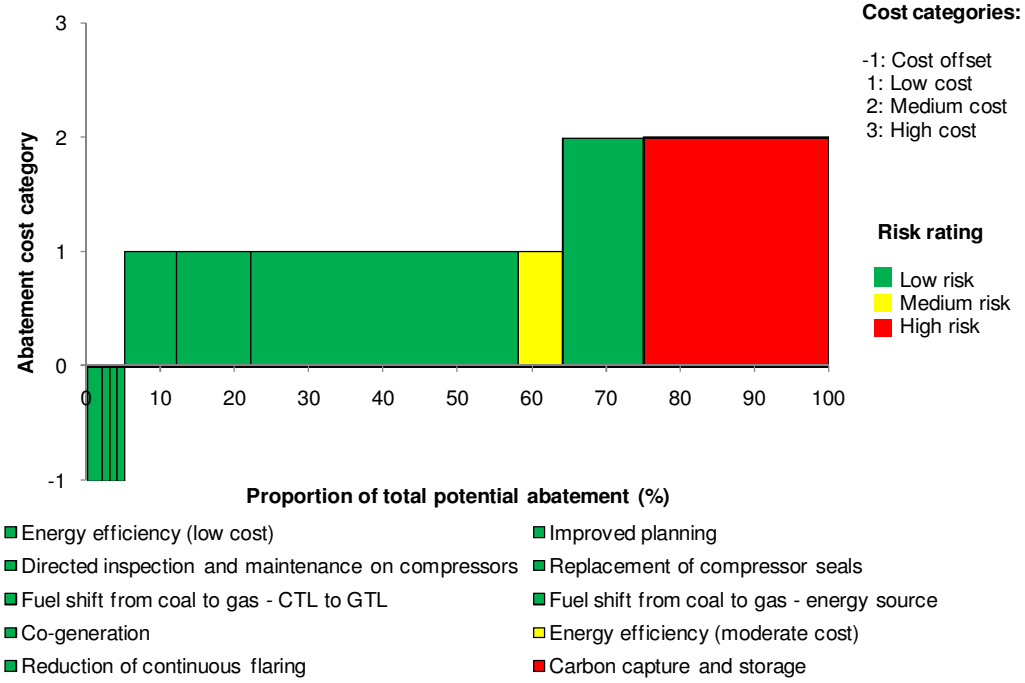


IACC: Chemicals
Source: Genesis Analytics, 2010

Based on the cost and risk ratings of available mitigation options in the sector, the *attractiveness of available mitigation options was ranked as "average"*.

Liquid fuels

To get a better understanding of mitigation options, the cost of available technology options, and the reductions that each technology could achieve, the liquid fuels sector needs to undertake plant level investigations of major sources of emissions. The abatement potential and costs of emissions reduction in the South African liquid fuels sector will depend on the industry's ability to implement on-site combined heat & power systems, reduce flaring and implement energy-efficiency opportunities, as well as on the future feasibility of carbon capture and storage. Alternative fuel sources such as natural gas also offer potential to mitigate GHG emission, as does improved planning. Because emissions reduction information in this industry tends to be project specific, the industry needs to be incentivised to share information dealing with climate change mitigation issues. Given South Africa's current "lock-in" on coal-to-liquid CTL as a guarantor of national fuel security, further research to develop alternative processes to retrofit CTL should also be considered. For benchmarking purposes it would be beneficial for local companies to improve their level of expertise in the usage of international protocols to quantify their GHG emissions.

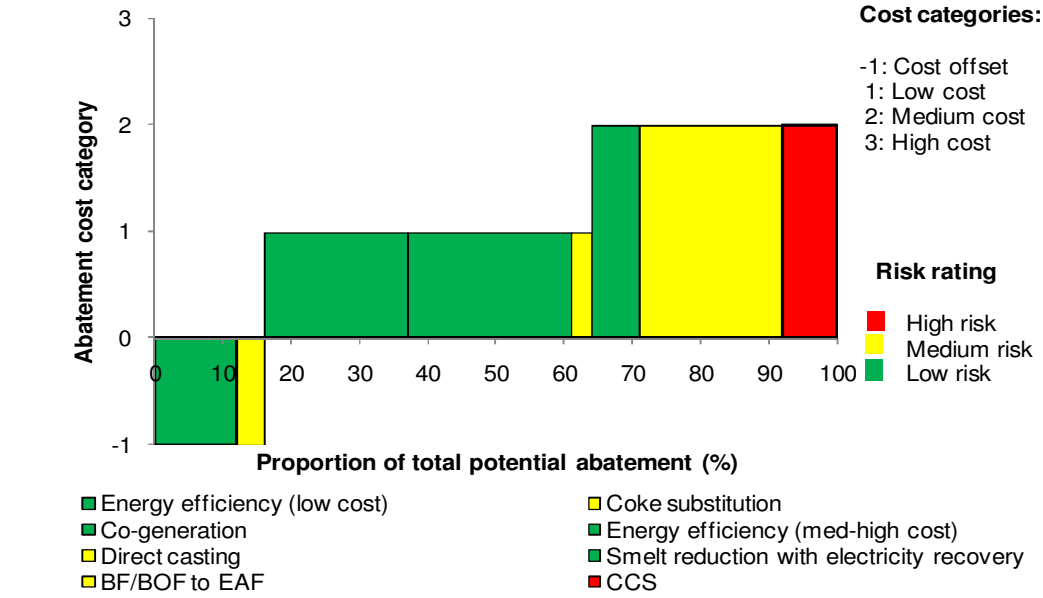


IACC: liquid fuels
Source: Genesis Analytics, 2010

Based on the cost and risk ratings of available mitigation options in the sector, the attractiveness of *available mitigation options was ranked as "average*".

Iron and steel

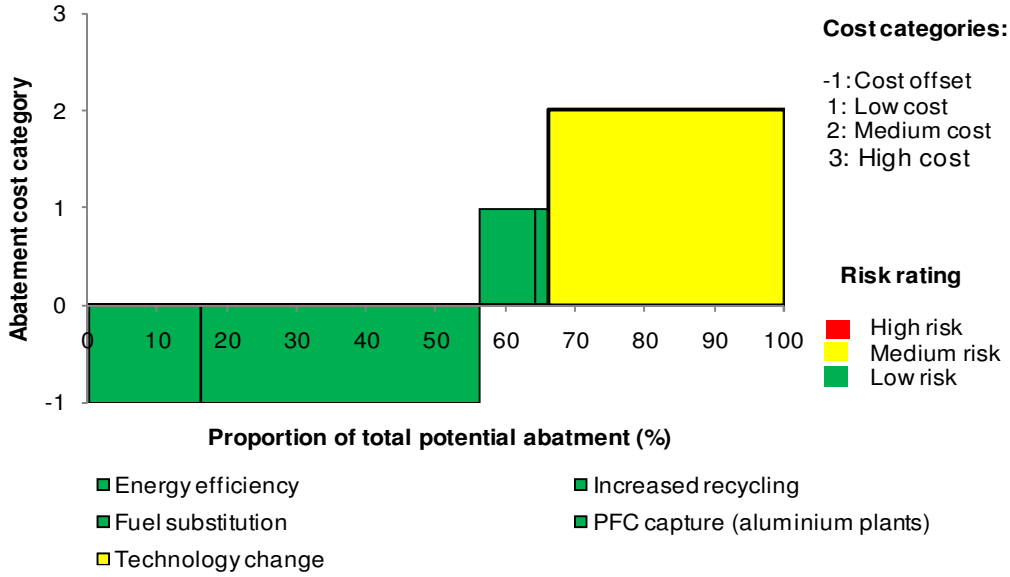
Typically in the order of 10 to 15% of total energy costs can be captured by energy reduction options with payback of less than two years. The primary barriers to realising these opportunities are typically organisational. Most companies already understand the rationale of switching to different approaches to cast and roll some specific steel products, e.g. direct casting. However such technology changes imply high switching costs and some level of risk, particularly if market conditions are uncertain and credit tight. These projects generally have positive returns over the long term, allowing a gradual migration to these technologies, e.g. new build only. Increased steel recycling and shifting technology from the blast furnace route to the electric arc furnace offers the most significant mitigating potential. However, this shift is somewhat constrained by the availability of scrap metal required by the EAF. An important mitigation option is therefore to increase iron and steel recycling in the SA economy.



IACC: Iron and steel
Source: Genesis Analytics, 2010

Based on the cost and risk ratings of available mitigation options in the sector, the *attractiveness of available mitigation options was ranked as "average"*.

Non-ferrous metals

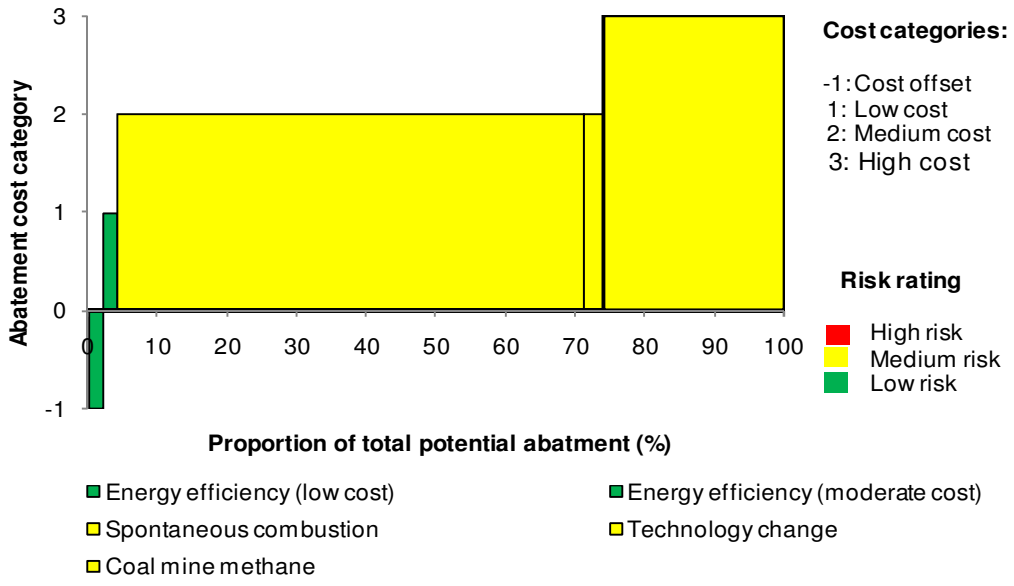


IACC: Non-ferrous metals
Source: Genesis Analytics, 2010

Sector-specific data is almost non-existent on the costs and emission reduction potentials associated with the various abatement options. Furthermore, indications are that those options that have received attention, e.g. PFC reduction from aluminium, are relatively insignificant for the sector. There is a strong need for the industry to establish baselines in terms of both emissions from the sector and the costs and emission reduction potentials associated with the various technologies identified here. Statistics on recycling are also very poor, which makes it difficult to assess the potentially large abatement potential from increased recycling. Based on the cost and risk ratings of available mitigation options in the sector, *the attractiveness of available mitigation options was ranked as "attractive"*.

Mining

Globally mitigation opportunities within the mining sector have tended to focus on coal mine methane projects (e.g. as seen by the large number of these projects taking place under the auspices of the Clean Development Mechanism). However, South African coal mines have relatively low concentrations of methane, and projects to capture and utilise the methane have generally been thought not to be economically viable. This might become less true in the future as deeper "gassier" coalfields are exploited. Furthermore, technological advancements may make this feasible even in low concentration mines. Nonetheless, fugitive emissions from coal mines are a very significant source of GHG emissions in South Africa. It is therefore an essential area to target, even though these projects are likely to prove costly. It is recommended that the cost of methane projects are further scrutinised to see if they are in fact prohibitive.



IACC: Mining
Source: Genesis Analytics, 2010

Energy efficiency mitigation opportunities will yield relatively minor results. These should still be pursued since their GHG savings are still significant in absolute terms. However, many of these measures are not routinely implemented on South African mines. The reasons for this need to be investigated and measures and incentives put in place to encourage their uptake (e.g.

overcoming inertia, and educating sector members as to the opportunities that exist). Spontaneous combustion does not occur at all opencast coal mines, and depends on the mining method and the nature of the overburden (its carbonaceous content) for underground mines. It is also a significant problem on waste dumps and abandoned mines. Low technology mitigation measures are reasonably successful, although fairly costly. Coal fires arising from spontaneous combustion is largely overlooked by the international community. The coal mining sector needs to be proactive in this regard through collaborative research projects.

Based on the cost and risk ratings of available mitigation options in the sector, the attractiveness of available mitigation options was ranked as "poor".

Case studies: general conclusions

The sector case studies showed that data on GHG emissions, abatement opportunities and mitigation costs is not readily available in South Africa. The data that does exist is too high-level to effectively inform policy development, which requires data at an individual process and SIC code to evaluate the impact of climate policies on individual sectors. It is therefore important that a detailed national GHG emissions inventory is developed which is in line with Statistics South Africa's SIC system. Additional detailed primary research is also required on the mitigation opportunities available to individual sectors. Detailed information can play a crucial role in identifying how best South Africa can capitalise on the opportunities offered by GHG mitigation. In the shorter term, if South African firms and industries can brand themselves as a "green" alternative, this could prove a substantial competitive advantage in developed country markets where consumers are much more discerning on sustainability issues.

Case studies: Key observations

A number of insights emerge (which will inform subsequent analysis) when the 7 IACCs in this section are considered together:

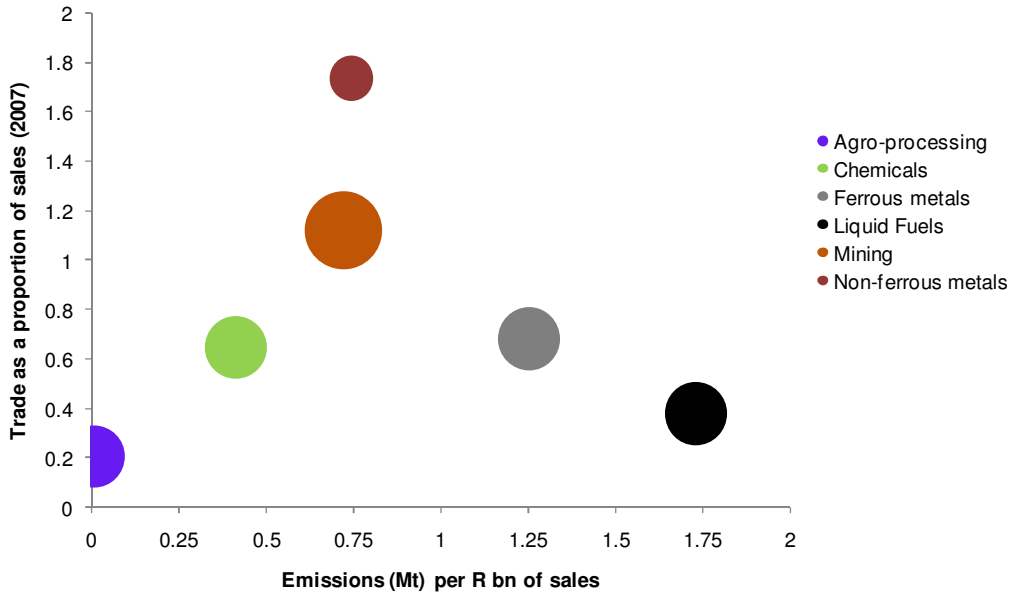
- In only 2 sectors (Liquid fuels and Chemicals) are significant amount of potential abatement reliant on high risk technologies.
- In all but 2 sectors (Electricity supply and generation and Mining) there are a number of low risk options available with negative or low cost ratings.
- In only 3 sectors (Chemicals, Iron and steel and Non-ferrous metals) do negative cost options make up more than 10 percent of total potential abatement.
- Only 1 high cost abatement option was identified (in the mining industry).
- 2 sectors face significantly poorer abatement opportunities that the rest. They are Electricity generation and supply and Mining.

IMPACT OF CLIMATE POLICIES ON INDIVIDUAL SECTORS

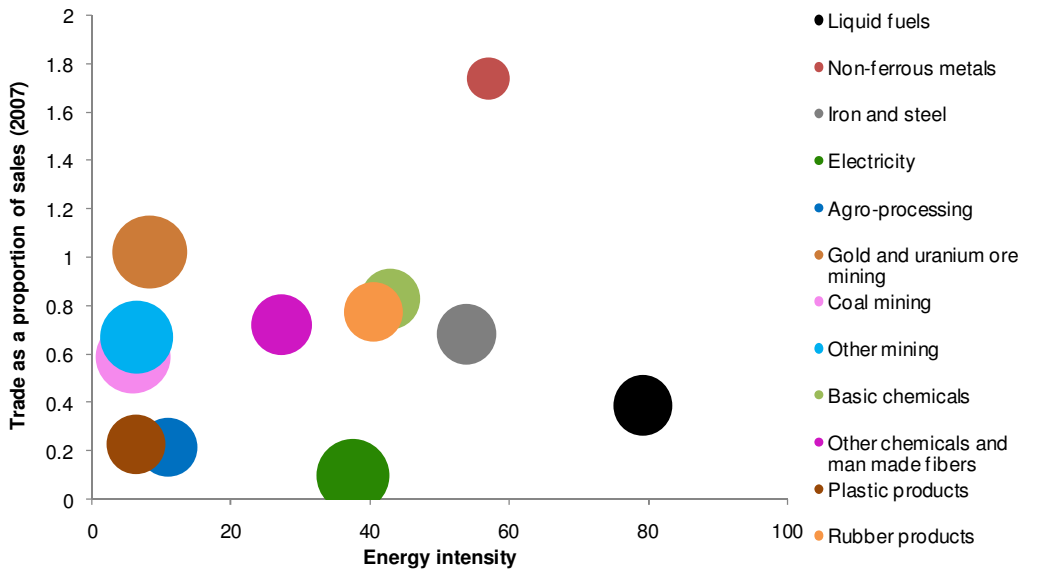
In order to evaluate the likely impact of carbon policies on individual sectors, a methodology was developed based on international precedents. The methodology utilises a proxy for the ability of the firms to pass on carbon costs to consumers without losing significant market share (which is ultimately what determines the impact of carbon policies on a sector) and three proxies for the likely cost increase that firms could face as the result of the introduction of a carbon price, to evaluate the vulnerability of sectors to competitiveness issues as a result of

carbon policies. Trade intensity is used as the proxy for the ability to pass on costs. Three proxies for likely cost increase are used because data issues make it unclear much confidence can be assigned to the results any one proxy. The three proxies are: emissions intensity (calculated based on best-available data); energy intensity; and electricity as a proportion of the total cost of firms. Sectors that sit towards the edges of the graphs that follow are considered to be more vulnerable to climate policies that sectors that sit towards the XY axis intersection (these sectors are likely to encounter higher costs as a result of a price on GHG emissions and have less scope to pass on costs to consumers).

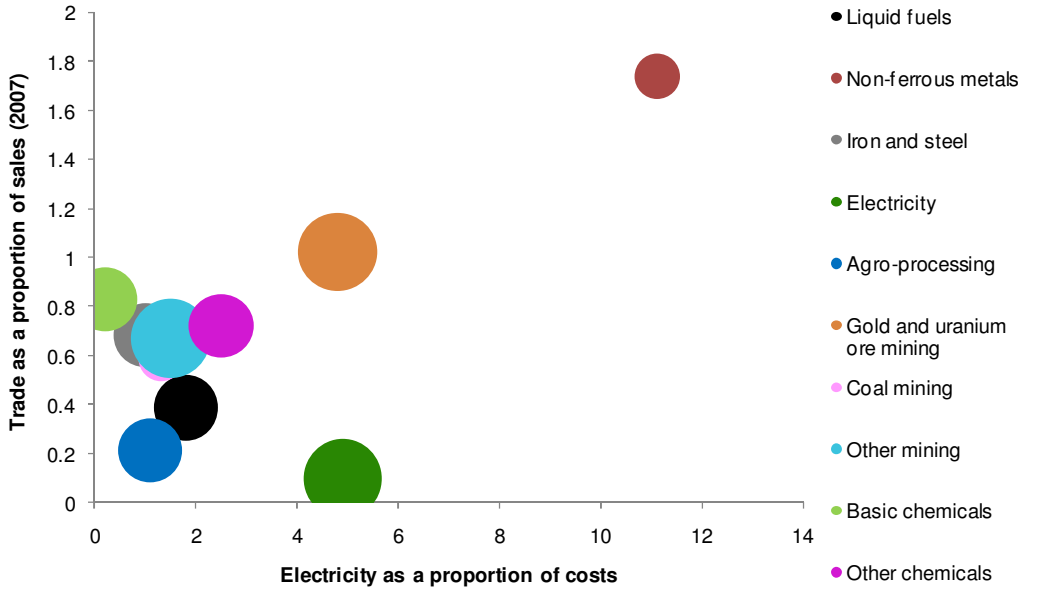
In addition, a qualitative measure of the attractiveness of the abatement options available to sectors based on the IACCs in the case studies are used to further inform the vulnerability of firms to climate policies. The larger the bubbles the less attractive the abatement options available to firms are believed to be, and thus the more vulnerable they will be to carbon policies.



Vulnerability to climate policies (emissions intensity as cost proxy)
Source: Genesis Analytics, 2010



Vulnerability to climate polices (energy intensity as cost proxy)
Source: Genesis Analytics, 2010



Vulnerability to climate polices (electricity costs as cost proxy)
Source: Genesis Analytics, 2010

The proxy chosen for exposure to carbon costs can have a significant influence on the outcome of the analysis. The liquid fuels sector was found to be the most emissions intensive (emissions per unit of revenue) and the most energy intensive (energy costs in relation to value-added), while the non-ferrous metals sector was the most electricity intensive (electricity cost as a proportion of total costs) and also the most exposed to international trade. Mining is also heavily traded and gold and uranium mining was found to be very energy and electricity

intensive. The basic chemicals, rubber products and ferrous metals sectors also appear to be relatively vulnerable to carbon costs as a result of a combination of high energy intensities and significant exposure to international trade. The assessment of the attractiveness of abatement options available to sectors indicates that the quantitative indicators alone potentially overestimate the vulnerability of the non-ferrous metals and ferrous metals sectors to carbon costs, while underestimating the vulnerability of the liquid fuels and mining sectors.

The analysis indicated that all the focus sectors (with the exception of agro-processing) are likely to be considered emission-intensive and trade-exposed based on best available data. Overall the findings of this analysis are consistent with international evidence that the likely impact of climate policies vary significantly betweens sectors, and that there are usually a few sectors that are expected to be disproportionally impacted. In the South African context, Liquid fuels and Non-ferrous metals seem to be particularly vulnerable to competitiveness concerns as a result of climate policies.

CLIMATE CHANGE INCENTIVES IN SOUTH AFRICA

From an economic theory and fiscal affordability perspective, incentives should play a supportive as opposed to a central role in the country's climate policy suite. Currently, the set of climate mitigation policies in place in South Africa is dominated by incentives, a situation which requires balancing out by other forms of policy instruments going forward. Given their fiscal burden, incentives should be used only where they are the most appropriate policy instrument. Theory advises that the use of incentives should focus either on addressing market failures, or smoothing the transition from one pricing environment to another. Whilst the REFIT is a highly appropriate use of an incentive mechanism (to address a market failure), additional intervention is required to unlock the institutional issues constraining its implementation. The use of tax exemption incentives for energy efficiency can be argued as less appropriate. Energy efficiency interventions also suffer from a market failure, but one which is likely to be automatically addressed as the electricity price inevitably rises. Energy efficiency is a negative cost mitigation option which faces non-price barriers which are more appropriately addressed through alternative policy mechanisms. Tax exemptions for the CDM may provide a stimulus to the use of this international mechanism, but again, other barriers still need to be removed before this incentive can take effect.

No incentives exist for R&D in any specific low emission technology currently, and these are recommended, both for the development of areas of competitive advantage for South Africa, and to adapt low emissions technologies to domestic circumstances. The current incentive package is focused exclusively on the energy sector with no transport sector incentives. Technologies such as the electric car may well afford the country a competitive advantage if their development is sufficiently resourced. Similarly, no incentives exist yet to smooth the transition to a low carbon economy for sectors vulnerable to a future carbon price. This is anticipated to be critical for a highly emissions intensive country like South Africa.

CONCLUSION – THE WAY FORWARD

Timeframes

As a developing country, South Africa has been able to delay its emissions peak to 2020 whilst retaining credibility in the international arena. In order to meet this peak, the LTMS shows that the country must embark immediately on an aggressive energy efficiency programme (the Start Now) scenario, whilst preparing the way for including a significant level of renewables and nuclear generation into the electricity grid, together with mitigation technologies in transport (electric cars), liquid fuels (carbon capture and storage) and others.

Therefore, apart from a few notable exceptions, the country has time to develop an optimal mitigation policy package to drive the implementation of the remaining LTMS wedges from 2020. These exceptions include ensuring the success of an aggressive energy efficiency drive, identifying areas where the country can capture new sources of international competitiveness, avoiding lock-in to technologies and new industries which will hamper emissions reduction into the future, and ensuring that policy, the regulatory environment, institutions, data, financing and technologies are in place to begin the implementation of low carbon options come 2020 if not before.

Policy development guidelines: use of economic instruments

In order to achieve the optimal level of GHG emissions abatement on a continuous basis, the cost of emissions must be incorporated into the price signals of the international economy. Economic theory indicates that this is most efficiently done through the use of a broad based economic or price instrument. A range of appropriate regulatory and incentive instruments will be important to support the emergence of a carbon price over time. These should be used to:

- accelerate investment in clean technologies whilst the carbon price is still too low to counteract their risk;
- in areas where non-price barriers exist which are more appropriately targeted through a non-price mechanism and before a significant carbon price comes into effect; and
- support vulnerable sectors to transform to a low carbon economic environment.

The LTMS scenario which comes closest to the medium and long term ambitions of the Peak, Plateau and Decline trajectory is 'Use the Market', which models the imposition of an escalating carbon price. *At present, however, there is insufficient information available regarding GHG emissions and abatement options at a sectoral level in South Africa to accurately determine what the impact of a given carbon price will be on individual sectors.* The timeframe discussion above, together with the analysis of optimal policy design outlined earlier in this paper recommends that climate policy development is approached slowly, with an emphasis on getting correct data, building consensus, and providing long, loud and legal policy signals so that the private sector has sufficient policy certainty to ensure optimal investment planning.

It is anticipated that the South African climate policy suite will eventually comprise a number of complimentary policy instruments, tailored to the country's specific circumstances. The components of this suite of policies will be the outcome of a policy development process that is likely to include extensive stakeholder engagement. The rest of this section thus provides

recommendations for possible policy options which could be considered for inclusion in the eventual suite of policies:

Generate Data. It is strongly evident in the sector case studies that there is a critical lack of data at a sectoral level in the country. In a sector like Agro-processing, for instance, it is almost impossible to draw any firm conclusions on the impact of climate policies on the sector because of the lack of available data. Gathering data must be prioritised in order to avoid inappropriate and potentially damaging policy. A delay in mandatory policy may be negotiated as an incentive for firms to disclose verified emissions data.

Pursue energy efficiency. An aggressive energy efficiency programme must be pursued, and could be supported by the PCP or similar white certificate scheme, with the steep electricity price escalation acting as a natural stimulus, and technology standards supporting the adoption of mature and standardised energy efficiency technologies. Attention will need to be paid to potential carbon leakages from an indirect policy instrument like the PCP. The sector case studies indicated that negative or low cost energy efficiency options were available to most of the sectors. The relative abatement potential of energy efficiency options, however, varies widely between sectors. The evidence from the sector case studies does question the assumption used in the LTMS that energy efficiency options are negative cost options. In only 2 of the 7 sectors do negative cost energy efficiency measures (including more energy efficient industrial motors) make up more than 10% of identified abatement potential.

Support technology development and adoption. Subsidies and incentives for R&D in strategic low carbon areas are required in advance of the introduction of a carbon price to develop a competitive advantage for the country, and to ensure the development of suitable technologies for South Africa's low carbon future. The REFIT is a good example of an appropriately applied subsidy, although the issues surrounding policy in the energy sector need to be resolved to enable the REFIT to be implemented. There are no existing direct incentives for R&D in any specific low emissions technology in South Africa. Low emissions R&D is indirectly covered by general incentives. Given the prevalence of inherently risky abatement options (an indication that the technology has not matured yet – leaving scope for further R&D) with high abatement potential in the sector case studies, there appears to be sufficient justification for incentives which target the creation of a competitive advantage in a particular technology with a view to capturing the market for this technology internationally (eg. Centralised solar thermal power generation). It is unlikely that the fiscus has the resources to incentivise R&D in all of these opportunities, but should rather focus on one or two more likely candidates which offer the best immediate prospects for abatement. The current incentive package is strongly focused on energy, with no incentives in the transport sector at all, although transport will play an important role in medium to long term emission reductions. South Africa is developing a competency in the electric car, and has an automotive sector which may be able to support the creation of a competitive advantage in this mitigation technology. Incentives would be very appropriate to support this emerging industry. A second suggested use of R&D incentives is to adapt existing low emissions technology for application in the South African environment, such as fine-tuning solar water heater design for the country's climate, manufacturing skills and natural resources.

Align climate and industrial policies. Climate and industrial policies should be aligned, ensuring low carbon criteria are incorporated in all industrial policy projects and decisions, and that climate change opportunities are exploited directly, with environmental goods and services prioritised as a sector for development.

Utilise voluntary measures. Voluntary mechanisms like reporting or emissions reduction agreements can build consensus on upcoming mitigation policy, introduce firms to the idea of reporting and verifying emissions, and generate much-needed data to inform the policy design process. The systematic exploitation of CDM opportunities (particularly programmatic CDM) could also provide access to substantial amounts of funding for abatement activities in South Africa at very little cost to government (the cost of unlocking blockages). Sector case studies identified opportunities for CDM projects in all the focus sectors apart from Non-ferrous metals.

Consider implementing a carbon price. The sector case studies showed that a relatively low cost carbon price would incentivise the uptake of emissions reduction technologies and lead to significant GHG reductions in all but two sectors, namely the Electricity generation and supply and Mining sectors (these are the only sectors where low cost abatement options does not account for at least 60 percent of available abatement opportunities). The two economic instruments available to implement a broad-based carbon price in South Africa are a carbon tax and an ETS. Theoretically it is also possible to implement these two instruments together. A carbon tax could be gradually introduced, preceded by, or in parallel with a voluntary data disclosure scheme with an incentive such as tax rebates for the first few years as a reward for full disclosure. The impact of the tax will be optimal if it is aimed at emissions at source. The tax could generate significant fiscal revenues and could ensure that the overall bundle of climate change policies is revenue neutral (i.e. it could offset the cost of other climate change policies). Targeted government transfers could be used to offset the impact of a carbon tax on the poor. An ETS would benefit from an initial voluntary phase to generate data and familiarise participants with the mechanics of emissions trading. It should have broad coverage to maximise efficiency. Initially permits may be grandfathered, but a relatively fast move to full auctioning is suggested to ensure fiscal, environmental and economic efficiency and to address equity concerns and potential barriers to entry. Market power and a lack of liquidity are likely to significantly impact any local ETS as a result of South Africa's emissions profile. A local ETS should thus either be linked to an accredited international ETS, or be designed to minimize the risk of disproportionate market power. It is important to consider the effect that a reduction in coverage to address market power may have on the scheme's efficiency. It this is not taken into consideration, the rationale for having an ETS in the first place may not be adhered to. The benefits of design features to reduce price volatility must be considered against their impact on emissions reduction certainty and increased administrative complexity.

Provide transitional assistance. As carbon prices or international discrimination based on carbon intensiveness of exports is introduced, transitional incentives can be used to ease the transition for vulnerable or trade intensive sectors. These are best used temporarily, and not to support highly emissions intensive industries in the long term. At present there are no incentives in place to smooth the transition to a low carbon economy for vulnerable sectors. This is anticipated to be crucial for an economy which is so dependent on highly energy intensive exports, and has many vulnerable sectors which are currently drivers of economic growth and employment. Partial or full temporary exemption from policies that implement a carbon price may provide temporary room for industries to increase their carbon efficiency. Subsidies and soft loans for energy and carbon efficient technologies are likely to play a role in assisting these industries to increase their GHG-emission efficiency. The analysis in section **Error! Reference source not found.** indicated that, consistent with international experience, there is likely to be a minority of local sectors that will be disproportionately affected by climate change policies. The Non-ferrous metals and liquid fuel sectors, in particular, seem highly vulnerable to competitive concerns. The sector case studies also showed that the attractiveness of available abatement options vary significantly between sectors, and that there are a minority of sectors that will find it particularly difficult to reduce their GHG emissions.

These two factors seem to indicate that targeted transitional assistance will be justified in South Africa. Sectors which may benefit from this type of assistance include Non-ferrous metals, Liquid fuels and Mining

Implement performance and technology standards. Performance and technology standards in general are not economically efficient and do not lead to lowest cost abatement. In South Africa, however, there are 2 instances where standards seem warranted. Technology standards supporting the adoption of mature and standardised energy efficiency technologies can be useful to support energy efficiency – provided that the technologies mandated are expected to lead to cost benefits or only negligible cost increases. Furthermore, in order to meet the Peak, Plateau trajectory, performance standards may be an effective instrument to ensure the necessary shift in generation mix to achieve the zero carbon grid envisaged by the 2050 30%- 40% target, given that Eskom is a regulated monopoly.

Consider transport emissions. Transport has been specifically excluded from this study, but being a significant source of emissions in the future warrants careful attention. Appropriate policy instruments for transport will be particularly important.

Sector actions

Based on the sector case studies a number of key actions can be highlighted that will enable focus sectors to engage constructively in the climate change debate and to assist them with moving towards low-carbon production (see section **Error! Reference source not found.** for more detail).

Agro-processing. There is a dearth of information regarding climate mitigation opportunities and emissions data in the Agro-processing sector. In addition, the study found that awareness of climate change issues and the particular risks and opportunities it poses for the Agro-processing industry need to be raised. Substantial research is required therefore to determine quantitative estimates of energy use and GHG emissions and to identify, quantify and consolidate the abatement potential offered by all potential abatement options in this sector.

Electricity generation and supply. The lack of implementation of policy in a co-ordinated fashion is currently hampering effective policy development and needs to be addressed. The cost profile of available abatement options means that this sector will need to find new ways of harnessing all potential energy sources in order to function effectively in a carbon constrained world. There are no low or no cost options available. Since electricity supply dominates carbon emissions and thus determines the carbon profile of most other industry, and given that assets in this sector are long lived and expensive, addressing the organisational issues in this sector should be a climate mitigation policy priority. Solar CSP appears to represent a potential source of competitive advantage for the country, and should be proposed for incentive funding. The way forward on nuclear needs to be clarified, with a plan for capturing technological competitive advantage (pebble bed modular reactor), or releasing funding for more promising technologies.

Chemicals. Reliable disaggregated GHG emissions data for the Chemicals sector needs to be generated. Electricity constitutes a significant proportion of the chemical industry's spend and energy efficient technologies are likely to become a significant source of competitive advantage in future. At an operational level, firms should identify high priority energy saving projects such as refraining from running equipment under no load, improving the Power Factor Correction (PFC), installing bearing technologies that are geared to reduce friction; improving the motor

electrical efficiency by carefully assessing the practice of rewinding of motors; and exploring utilising smaller motors. Significant revenue growth for specialty chemical firms may be derived from the development and marketing of chemical products which help to reduce energy consumption as well as materials for new energy technologies like solar photovoltaic cells and fuel cells). The Chemical sector is a potentially vulnerable sector to climate mitigation policies, and should therefore prioritise data collection and early action in energy efficiency to motivate for transitional subsidy protection in the future.

Liquid fuels. Plant level investigations of major sources of emissions should be undertaken to form a better understanding of the availability and cost of abatement technologies and potential GHG reductions. Emissions reduction information tends to be project specific, highly proprietary and un-transparent. The industry needs to be incentivised to share information dealing with climate change mitigation. Improvement in the local level of expertise in the usage of international protocols to quantify their GHG emissions would be beneficial for benchmarking purposes. The abatement potential and costs of emissions reduction in the South African liquid fuels sector will depend on the industry's ability to capture CHP, reduce flaring and implement energy-efficiency opportunities, as well as on the future feasibility of carbon capture and storage. Alternative fuel sources such as natural gas should be considered and supported. Strategically, improved planning is the key to improved implementation and operation. Given South Africa's current "lock-in" on CTL as a guarantor of national fuel security, further research to develop alternative processes to retrofit CTL should also be considered. The sector should promote CCS as a potential recipient of R&D incentive financing, with decision points identified for the viability of the technology.

Iron and steel. Driving towards more energy-efficient processes should remain one of the main focuses of the iron and steel industry. Technologies with a payback period of less than two years could generate savings in the order of 10 to 15% of total energy costs. The primary barriers to realising these opportunities are typically organisational and should be addressed. Increased steel recycling and shifting technology from the blast furnace route to the electric arc furnace offers the most significant mitigating potential. This shift is somewhat constrained by the availability of scrap metal required by the EAF. An important mitigation option is therefore to increase iron and steel recycling in the SA economy. As a sector potentially vulnerable to climate mitigation policies, this sector will need to justify the use of transitional subsidies, and early action on energy efficiency may stand the sector in good stead.

Non-ferrous metals. Sector specific data is almost non-existent on the costs and emission reduction potential of individual abatement options. Indications are that those options that have received attention, e.g. PFC reduction from aluminium, are relatively insignificant. To better be able to engage with government, there is a need for the industry to establish baselines in terms of both emissions and the costs and emission reduction potentials associated with various abatement technologies. Statistics on recycling are also poor and need to be improved to be able to assess the potentially its large abatement potential. As a particularly vulnerable sector to climate policies (highly traded and emissions intensive), it is strongly in the sector's interests to provide the data which justifies potential transitional subsidies.

Mining. Globally mitigation opportunities within the mining sector have tended to focus on coal mine methane projects. South African coal mines have relatively low concentrations of methane, and projects to capture and utilise the methane have generally been thought to be economically unviable. It is important to investigate technology advancements that could make methane projects feasible in low concentration mines given that fugitive emissions from coal mines are a significant source of GHG emissions in South Africa. It is important to gain a better

understanding of methane project costs to confirm if costs really are prohibitive locally. Energy efficiency mitigation opportunities will yield relatively minor results, but their GHG savings are still significant in absolute terms. It is important to investigate the reasons why many of these measures are not routinely implemented. Spontaneous combustion in coal mines is a significant issue. It also affects waste dumps and abandoned mines. Low technology mitigation measures are reasonably successful but fairly costly in avoiding coal fires arising from spontaneous combustion. The issue of spontaneous combustion in coal mines is largely overlooked and the reasons for this needs to be investigated and addressed. Similarly to metals and chemicals, mining is an emissions and trade intensive sector, and will have to justify the use of transitional subsidies.