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POLICY PAPER FOR PUBLIC COMMENT

CARBON TAX POLICY PAPER

Reducing greenhouse gas emissions and facilitating the transition to a green economy

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Acronyms and abbreviations

ACSA	Airports Company South Africa
AUD	Australian dollar
BACT	best available control technology
BCA	border carbon adjustment
BTA	border tax adjustment
BAU	business-as-usual
°C	degrees Celsius
$CaCO_3$	calcium carbonate
CAD	Canadian dollar
CAI	Chartered Accountants Ireland
CCEMF	Climate Change and Emissions Management Fund
CCERs	Chinese Certified Emissions Reductions
CCGT	closed cycle gas turbine
CCS	carbon capture and storage
CDM	Clean Development Mechanism
CER	certified emissions reduction
CGE	computable general equilibrium
CH_4	methane
CH_3OH	methanol
CIT	corporate income tax
CO_2	carbon dioxide
CO_2-eq	carbon dioxide equivalent (also CO_2-e)
COP	Conference of the Parties
CSI	Cement Sustainability Initiative
CSP	concentrating solar power
CWT	complexity weighted ton
DEA	Department of Environmental Affairs
DEAT	Department of Environment Affairs and Tourism
DME	Department of Minerals and Energy
DoE	Department of Energy
€	euro
EDD	Economic Development Department
EEDSM	energy efficiency demand-side management
EITI	energy intensive and trade intensive
ENCC	National Strategy for Climate Change (Estrategia Nacional de Cambio Climático)
EPC	emissions performance credit
EPS	Payment for Environmental Services (El Pago de Servicios Ambientales)
EPWP	Expanded Public Works Programme
ERC	Energy Research Centre
ESCert	Energy Saving Certificate
ETS	emissions trading system/scheme
EU	European Union
EU ETS	European Union Emissions Trading System

EVO	Efficiency Valuation Organisation
GDP	gross domestic product
Gg	gigagram
GHG	greenhouse gas
GJ	gigajoule (10^9 or one thousand million joules)
IAI	International Aluminium Institute
ICAO	International Civil Aviation Organisation
IMO	International Maritime Organisation
INEP	Integrated National Electrification Programme
INR	Indian rupee
IPAP	Industrial Policy Action Plan
IPCC	Intergovernmental Panel on Climate Change
IPMVP	International Performance Measurement and Verification Protocol
IPP	independent power producer
IRP	Integrated Resource Plan
kg	kilogram
kW	kilowatt (1 000 watts)
kWh	kilowatt-hour
LTMS	long-term mitigation scenarios
MJ	megajoule (10^6 or one million joules)
MRV	measurement, reporting and verification
Mt	million tons
MW	megawatt
MWh	megawatt-hour
N_2O	nitrous oxide
$NaCO_3$	sodium carbonate
NAMA	nationally appropriate mitigation action
NATMAP	National Transport Master Plan
NCASI	National Council for Air and Stream Improvement Inc.
NCEF	National Clean Energy Fund
NCPC	National Cleaner Production Centre
NDP	National Development Plan
Nersa	National Energy Regulator of South Africa
NGO	non-governmental organisation
NGP	New Growth Path
NH_3	ammonia
NPC	National Planning Commission
NT	National Treasury
OCGT	open cycle gas turbine
PAT	Perform, Achieve and Trade
PFC	perfluorocarbon
PIT	personal income tax
PPA	power purchase agreement
ppm	parts per million
PV	photovoltaic

R&D	research and development
REFSO	Renewable Energy Finance and Subsidy Office
REIPP	Renewable Energy Independent Power Producer
RSA	Republic of South Africa
SACAA	South African Civil Aviation Authority
SACU	Southern African Customs Union
SANBI	South African National Biodiversity Institute
SARi	South African Renewables Initiative
SEC	specific energy consumption
SEI	Stockholm Environment Institute
SWH	solar water heater
t	(metric) ton
tCO_2	ton of carbon dioxide
tCO_2-eq	ton of carbon dioxide equivalent (also tCO_2-e)
toe	ton of oil equivalent
UNFCCC	United Nations Framework Convention on Climate Change
UNU	United Nations University
US$	American dollar
VAT	value-added tax
WBCSD	Word Business Council for Sustainable Development
WC/WDM	Water Conservation and Water Demand Management
WIDER	World Institute for Development Economics Research
WTO	World Trade Organisation
ZAR	South African rand

Executive summary

1. This Carbon Tax Policy Paper is an update of the carbon tax discussion paper published for comment in December 2010. The policy paper takes into account the comments received, and elaborates on and contextualises the specific carbon tax design features briefly discussed in the 2012 Budget Review. The proposed carbon tax will be phased in to allow for a relatively smooth transition to a low-carbon economy. This gradual approach will send the necessary policy and price signals to investors and consumers of the need to ensure that future investments are more climate resilient. This will minimise the need for retrofitting, as well as the risk of embarking on redundant large-scale major capital projects and investments.

2. Taking action now in a phased manner will reduce the risk of South Africa's exports being subject to border carbon adjustment (BCA) tariffs, and will allow for the early development and/or implementation of cleaner technologies. A carbon tax will also enhance the development of technologies for capturing and storing carbon. It is proposed that the carbon tax be introduced as part of a package of interventions to ensure that the primary objective of greenhouse gas (GHG) mitigation is achieved, and to minimise potential adverse impacts on low-income households and industry competitiveness.

3. Addressing the challenges of climate change through facilitating a viable and fair transition to a low-carbon economy is essential to ensure an environmentally sustainable economic development and growth path for South Africa. The government has taken important steps to coordinate and develop a coherent policy framework to curb GHG emissions by 34 per cent by 2020 and 42 per cent by 2025 below the business-as-usual (BAU) trajectory, subject to the provision of adequate financial, technological and capacity-building support by developed countries. The National Climate Change Response White Paper (henceforth the 2011 White Paper) provides an overarching policy framework for enabling this transition in the short, medium and long term. It elaborates on the government's role in developing and implementing a suite of policy measures and strategies aimed at both mitigating and adapting to the impacts of climate change.

4. The cross-cutting nature of climate change requires taking a multipronged policy approach comprising market-based and regulatory measures, information awareness programmes and voluntary initiatives. In order to ensure that climate change mitigation is cost effective, the transition of key sectors (such as electricity generation, liquid fuels, transport and certain industrial processes) is crucial. The 2011 White Paper supports the implementation of a carbon price through a carbon tax as an instrument to encourage such mitigation as a complement to regulatory measures. It also highlights taking a carbon budgeting approach to measuring and monitoring the effectiveness of both existing and proposed policies, as well as identifying short-term flagship programmes that focus on the energy, transport and waste sectors.

The government's climate change policy framework and policy coherence

5. The 2011 White Paper, developed by the Department of Environmental Affairs (DEA), seeks to ensure a coordinated and consistent policy framework to address climate change, and to align

and contextualise efforts in this regard across government. It sets the vision for managing the impacts of climate change effectively through adopting appropriate policy interventions to guide the transition to a climate-resilient, low-carbon economy. This requires effort targeted at mitigating the effects of climate change; adapting processes, systems and approaches; building technology and capacity; mobilising financial resources; and developing an appropriate system for monitoring and evaluation.

6. The government has developed broad policy frameworks that identify climate change as a key challenge. Several initiatives for managing the transition to a low-carbon and green economy have been announced, and these need to be aligned to help address various environmental challenges, including climate change.

Why the need for a carbon price?

7. Environmental challenges, such as climate change, air and water pollution, occur when the assimilative capacity of a particular environmental resource is exceeded. Society is affected by the resulting pollution, and the polluter is often not held accountable for the costs of such pollution. In economic theory, this is defined as a negative environmental externality, and therefore a market failure, because the costs of pollution are not reflected in the final prices of the goods and services. In order to correct market failures and include these external costs in the prices of goods and services, and hence ensure efficient and environmentally beneficial outcomes, the government intervenes by way of regulations or market-based instruments to influence the decision-making processes of producers and consumers.

8. Regulatory measures include emissions standards and the banning of certain goods and services. Market-based instruments comprise levying environment-related taxes, allocating pollution rights through tradable permit systems, and granting subsidies for environmental improvements. Regulatory, command-and-control policies require quantitative restrictions on the level of pollution allowed. Market-based instruments operate through the price mechanism and involve setting a price on the unpriced element or pollution causing the initial market distortion. The outcomes of command-and-control measures are often not economically efficient, as all firms need to comply with specific restrictions regardless of the costs of compliance or mitigation to individual firms. Market-based instruments offer firms flexibility in reducing their emissions tax liability, based on the specific costs they face in abatement.

9. A carbon price can drive changes in producer and consumer behaviour, and in so doing address climate change:

- First, carbon pricing will encourage a shift in production patterns towards low-carbon and more energy-efficient technologies by altering the relative prices of goods and services based on their emissions intensity, and by encouraging the uptake of cost-effective, low-carbon alternatives.
- Second, the carbon-intensive factors of production, products and services are likely to be replaced with low-carbon-emitting alternatives. In order to achieve the extent of emissions reduction committed to under the Copenhagen Accord, the consumption of certain carbon-intensive products (e.g. cement, steel and aluminium) need to be reduced and/or the production technologies have to become less carbon intensive. Given that these industries are important for the country's proposed infrastructure building programme, appropriate

policies are required to ensure that mitigation and adaptation strategies are taken into account in investment decisions with long-term lock-in effects.

- Third, a carbon price will create dynamic incentives for research, development and technology innovation in low-carbon alternatives. It will help to reduce the price gap between conventional, carbon-intensive technologies and low-carbon alternatives.

10. Ideally, a carbon price should reflect the marginal external damage costs of carbon emissions. Several studies have attempted to quantify the costs of climate change to society. The levels of carbon prices required to achieve a certain desired level of emissions reduction range from an estimated US$8 to over US$300.

Carbon tax versus emissions trading systems

11. In principle, both a carbon tax and an emissions trading system (ETS) use the market to stimulate reductions in GHG emissions. Carbon taxes work by pricing emissions directly, while ETSs operate by setting a cap on the level of emissions allowed. Firms are then allocated allowances (to be auctioned over time) which they may trade with other firms, depending on their abatement costs. Taxes provide certainty with respect to price, but no certainty with regard to emissions reductions. An ETS, however, provides certainty of the emissions reduction levels to be achieved, but not of the resulting carbon price.

12. In the South African context, a carbon tax is more appropriate than a cap-and-trade scheme in the short to medium term because of the oligopolistic nature of the energy sector. A carbon tax can be complemented or replaced by an ETS at a later stage. It should be noted that, in the EU, currently only about 45 per cent of GHG emissions are covered by the European Union Emissions Trading System (EU ETS).

13. An ETS involves a fixed cap on emissions at a country level. As a developing country, South Africa is categorised as a non-Annex 1 country under the Kyoto Protocol. It does not (as yet) face a binding target for emissions reduction in line with the principle of common but differentiated responsibilities and respective capabilities. However, South Africa made a voluntary commitment to curbing emissions relative to the business-as-usual emissions trajectory, and in line with a peak, plateau and decline trajectory. This will provide the necessary flexibility and space for the country's economic development needs while also addressing environmental problems, such as climate change.

14. Setting a fixed target or emissions cap relative to a specific base year for South Africa would require rapid reductions in GHG emissions over a relatively short timeframe. In order to work effectively, an ETS needs a sufficient number of entities participating in the scheme, as well as adequate trading volumes to generate an appropriate carbon price. In South Africa, the oligopolistic nature of the energy sector may fail to meet these requirements.

15. Current experience with the implementation of cap-and-trade systems, such as the EU ETS, has shown that trading schemes provide certainty with respect to the levels of emissions reductions required. However, if allowances are inappropriately allocated or over-allocated (as in the EU ETS case during its first phase), it drives down permit prices and creates longer-term market distortions. Consequently, critical investment decisions are delayed. In addition, dynamic economic incentives for further investments in research, development and technology

innovation may be deterred due to uncertainties arising from inconsistent (and very volatile) carbon prices. There have been attempts to refine the design of the EU ETS to provide longer-term price certainty, and to streamline the allocation methodology in order to combine an absolute emissions methodology with proper carbon intensity-based benchmarks for qualifying sectors.

16. The complexities of an ETS are also evident in the Australian example. Although the intention in Australia is to move to an ETS, the price of carbon will be fixed for the first three years (2012–15). When the system is eventually converted into an ETS resulting in a flexible carbon price, it will be accompanied by floor-and-ceiling carbon prices.

Economic impact of a carbon tax for South Africa – modelling results

17. Several studies modelling the broad macroeconomic impact of a carbon tax for South Africa have been undertaken by, for instance, the World Bank, DEA (University of Cape Town for the Long-Term Mitigation Scenarios study), University of Pretoria and National Treasury. All these studies indicate that the transition to a low-carbon, climate-resilient economy will depend on the current structure of the economy; the incentives for technical and behavioural changes, the way in which revenue is recycled, and the extent to which energy, transport, industrial and trade policies are coordinated with environmental policy.

18. The National Treasury's modelling is based on a dynamic computable general equilibrium (CGE) model that seeks to capture the complex economic relationships between producers and consumers, and between domestic and foreign economies. The study models the impacts of a carbon tax imposed upstream on fossil fuel inputs (coal, crude oil and natural gas) and implemented gradually over a period of 10 years. The impacts of the carbon tax on key variables are considered over a period of 25 years, including the level of emissions reductions, overall output, employment, investment, competitiveness of different sectors, and different income groups.

19. Several scenarios, including revenue recycling options, were modelled to examine the broad impacts on the outputs from different sectors. Revenue recycling options include reductions in taxes, such as corporate income tax, personal income tax, direct transfers to households and higher levels of investment by the government.

20. The model suggests that a carbon tax, coupled with various revenue recycling options, will have a limited negative impact on economic growth and will assist in nudging the economy onto a more sustainable and low-carbon growth path. Evidence suggests that tax shifting (which involves taxing "bads", such as pollution and GHG emissions, and reducing taxes on "goods", such as payroll and income) could generate both environmental and employment benefits. The most positive impacts for the recycling of revenue emanate from the channelling of funds towards new productive investments in the respective sectors. There may be scope for further investment in low-carbon technologies by both the government and the private sector.

21. The petroleum, mining and chemicals sectors are experiencing lower levels of growth, while the agriculture, food, textiles, vehicles and tertiary sectors are seeing more robust growth. This shift in the economic structure is part of the adjustment process towards a greener economy. It reflects

the impact of the carbon tax in changing the structure of the economy and achieving greener growth and reduction in emissions.

22. The modelling exercise concluded that a carbon tax with broad sector coverage was desirable from the perspective of environmental and economic efficiency. In line with other studies (as cited), the results further indicate that a carbon tax that is implemented gradually and complemented by effective and efficient revenue recycling can contribute to significant emission reductions; have a largely neutral impact on economic growth, employment and income inequality; and facilitate the transition to a low-carbon, greener economy.

23. The country is facing structural, technical and practical challenges in its efforts to manage the transition to a low-carbon economy while also addressing other critical socioeconomic priorities. The proposed design of the carbon tax endeavours to balance these challenges with the efficiency gains of a broad-based carbon tax.

24. Although the study estimates the required levels of emissions reductions, the model is unable to quantify any concurrent benefits of such reductions. It could therefore be argued that reported results will tend to overestimate the costs of a carbon tax and underestimate the benefits from the lower levels of emissions.

International carbon pricing policies

25. Several countries have implemented carbon pricing policies, including, both carbon taxes and cap-and-trade schemes, as well as hybrids of these instruments. In the early 1990s, many European countries, particularly the Scandinavian nations, began implementing energy and carbon taxes aimed at reducing emissions and raising revenues. In 2005, the EU introduced the EU ETS and several sectors previously covered by carbon taxes were absorbed into the trading system. Developing countries, such as India, have implemented a modest proxy carbon tax on coal. China is piloting several ETSs as part of its response to climate change as well as considering an introduction of a carbon tax. Australia's carbon pricing regime comprises a fixed carbon price (carbon tax) in the initial stages, which will be converted to an emissions regime thereafter.

- The key design considerations and lessons learnt from these countries' experiences with regard to carbon taxes are as follows: In most European countries, carbon taxes were introduced incrementally by either increasing the rates over time or gradually extending the tax coverage and removing exemptions and rebates for sensitive industries. Introduced in 1990, Finland's carbon tax initially applied to heat and electricity production and was later expanded to cover transportation and heating fuels. Sweden and Denmark applied a system of progressive reduction of exemptions. Ireland introduced a carbon tax in 2010 to complement the EU ETS and to capture emissions not covered by the EU ETS, by including mainly transport, waste and heat in buildings. The initial carbon tax rate, applied in 2010 and 2011, was set at €15 per tCO2 and was subsequently increased to €20 in 2012.
- The adoption of a phased-in, gradual approach to the implementation of carbon taxes is important. Introducing the tax at an initial low rate and allowing for incremental increases over time enhances the acceptability of the tax. A phased-in approach, with an initial modest rate, provides certainty to industry sectors and allows emitters time to adjust. In 2002, Denmark implemented a system of high initial refunds, which was decreased over time for

low-sulphur fuel oil. Structured, automatic adjustments send a clear price signal for long-term investment decisions and also encourage behavioural responses, even at low tax rates.

- Transitional relief measures for certain sectors were deemed justified, in the form of free allowance in the case of an ETS, as well as lower tax rates or partial exemptions to address competitiveness concerns in the absence of an internationally harmonised carbon price or carbon tax.
- Revenues have been recycled through reductions in other distortionary taxes (e.g. payroll taxes), targeted, direct support to households, incentives for research and development, energy efficiency savings, and renewable energy.

Design features of a carbon tax for South Africa

Tax base

26. The 2010 carbon tax discussion paper proposes three options for implementing a comprehensive carbon price through the carbon tax, and defines the following tax bases:

- Tax applied directly to measured GHG emissions
- Fossil fuel input tax on coal, crude oil and natural gas, based on their carbon content
- Tax levied on energy outputs (electricity and transport fuels).

27. The best option is to impose the levy directly on the emissions of actual GHG or carbon dioxide equivalents (CO_2-eq). However, such a tax on actual emissions appears to be administratively complex.

28. A second option, and potentially an equivalent tax base to that of a directly measured emissions tax, is the imposition of a tax on fuel inputs. The tax is based on either appropriate emissions factors or a transparent and verified measuring and monitoring procedure. This alternative procedure may be necessary in the case of process emissions resulting from the chemical reactions of certain manufacturing processes, such as cement, glass, aluminium and chemicals production.

29. Following extensive consultation, a preference for a fuel input tax emerged. It was agreed that emissions factors and/or procedures are available to quantify CO_2-eq emissions with a relatively high level of accuracy for different processes and sectors. The DEA will approve the appropriate emissions factors and procedures, in line with international information published by the Intergovernmental Panel on Climate Change (IPCC). According to the 2011 White Paper, the DEA will introduce mandatory reporting of GHG emissions for entities, companies and installations that emit in excess of 100 000 tons of GHGs annually, or consume electricity that results in more than 100 000 tons of emissions from the electricity sector.

30. The sources of GHG emissions are diverse and include direct GHG emissions from sources that are owned or controlled by the entity (Scope 1); indirect GHG emissions resulting from the generation of electricity, heating and cooling, or steam generated off site but purchased by the entity (Scope 2); and indirect GHG emissions (not included in scope 2) from sources not owned or directly controlled by the entity but related to the entity's activities (Scope 3). Sectors across the board and also consumers will be impacted either directly or indirectly by the carbon tax as

it filters through the economy.

31. In absolute terms, total GHG emissions in 1994, 2000, and 2010 amounted to 380, 461, and 547 million tons, respectively. Emissions from the energy sector due to electricity generation, petroleum refining and transport accounted for more than 80 per cent of total emissions in 2000, followed by the agricultural and industrial sectors at 8.4 and 7 per cent, respectively.

32. The carbon tax will only cover Scope 1 emissions in the tax base; that is, emissions that result directly from fuel combustion and gasification, and from non-energy industrial processes. Scope 1 emissions include carbon dioxide, methane, nitrous oxide, perfluorocarbons, hydrofluorocarbons and sulphur hexafluoride. Complementary measures and incentives (such as the proposed energy efficiency savings tax incentives) will be introduced to encourage businesses to reduce their Scope 2 emissions; that is, indirect emissions resulting from a firm's use of purchased electricity, heat or steam.

Proposed sector tax-free thresholds

33. Taking cognisance of the (as yet) lack of an agreement on an international harmonised carbon price, and seeking to ensure a relatively smooth transition to a low-carbon economy, the carbon tax design incorporates tax-free thresholds that are subject to review after five years. These tax-free thresholds take into account the competitiveness concerns of locally based and trade-exposed carbon-intensive sectors and businesses, as well as distributional concerns, such as the impact on low-income households. These temporary or transitional tax-free thresholds are similar to the free allowances under the EU ETS and other ETSs. The proposed carbon tax policy comprises the following key elements:

- A percentage-based threshold on actual emissions is applied, below which the tax will not be payable during the first five years.
- Consideration will be given to sectors where the potential for emissions reduction is limited for either technical or structural reasons, such as process emissions. Initial indications suggest that this will include the cement, iron and steel, aluminium and glass sectors.
- Graduated relief is given to trade-intensive sectors.
- Offsets can be used by firms to reduce their carbon tax liability up to a limit. Variable offset limits are proposed based on the mitigation potential of the sector.
- The overall maximum tax-free threshold (including the offsets and possible adjustments to the basic 60 per cent tax-free threshold for carbon intensity) is limited to 90 per cent, except for those sectors that have been completely excluded during the first five-year period.

34. Table 1 summarises the proposed tax-free thresholds for the CO_2-eq emissions tax and the maximum allowable percentage offsets.

Table 1: Proposed emissions tax-free thresholds

Sector	Basic tax-free threshold (%)	Maximum additional allowance for trade exposure (%)	Additional allowance for process emissions (%)	Total (%)	Maximum offset (%)
Electricity	60	–	–	60	10
Petroleum (coal to liquid; gas to liquid)	60	10	–	70	10
Petroleum – oil refinery	60	10	–	70	10
Iron and steel	60	10	10	80	5
Cement	60	10	10	80	5
Glass and ceramics	60	10	10	80	5
Chemicals	60	10	10	80	5
Pulp and paper	60	10	–	70	10
Sugar	60	10	–	70	10
Agriculture, forestry and land use	60	–	40	100	0
Waste	60	–	40	100	0
Fugitive emissions from coal mining	60	10	10	80	5
Other	60	10	–	70	10

35. Firms will be encouraged to reduce the carbon intensity of their products. This will be accommodated by adjusting the basic tax-free threshold of 60 per cent by a factor (*Z*), calculated with reference to either the agreed benchmark emissions intensity (including both Scope 1 and Scope 2 emissions) for the sector, or the emissions intensity (including both Scope 1 and Scope 2 emissions) with reference to an historical date. Essentially, firms below the benchmark emissions intensity (including both Scope 1 and Scope 2 emissions) will be rewarded and firms above it will be penalised. Adjustments to the 60 per cent basic tax free threshold will be limited to 5 percentage points, up or down.

36. As per Table 1, the agriculture, forestry, land use and waste sectors will be excluded during the first five-year period, largely due to administrative difficulties in measuring and verifying emissions from these sectors. The intention is to include them in the carbon tax regime after the first five-year period. The proposed tax-free percentage thresholds and the offsets for the different sectors will remain fixed during the first phase (2015–19). The percentage tax-free thresholds will be reduced thereafter and may be replaced with absolute emissions thresholds. Both the tax-free percentage thresholds and their subsequent replacement with absolute emissions thresholds should be aligned with other initiatives.

37. One of the challenges in applying a comprehensive, broad-based carbon tax is to consider opportunities that are available for mitigation. It could be argued that emissions from chemical processes that occur in fixed stoichiometric ratios (e.g. coal gasification, crude oil cracking and

the production of cement, iron, steel, glass, ceramic and certain chemicals, such as calcium carbide and titanium dioxide) have limited potential for mitigation over the short to medium term. A system of offsets is proposed that will allow greater flexibility to reduce emissions on the margin via investments outside a specific sector. The 2011 White Paper also recognises that offsets could help to incentivise biodiversity conservation, and it commits to developing carbon offset programmes actively.

38. It is proposed that initially firms could use verified offsets developed under internationally recognised carbon offsetting standards (e.g. Clean Development Mechanism (CDM) and Verified Carbon Standard (VCS)) to reduce their carbon tax liability by up to 5 or 10 per cent of the actual emissions, as indicated in Table 1 above. Initial ideas regarding the proposed offset mechanism is included in Annexure E. A separate paper elaborating on design features for the offset mechanism will be published for comment later this year.

Proposed carbon tax rate

39. In principle, an environmentally effective and efficient carbon tax should aim for broad coverage, with minimum exemptions and exclusions for different GHGs and sectors, and applied at a rate equivalent to the marginal social damage costs. The aim of the proposed carbon tax is to correct the existing prices of goods and services that generate excessive levels of anthropogenic GHG emissions, so that it reflects the social costs of such emissions. GHG emissions accumulate in the atmosphere, which means that current emissions will contribute to the stock of emissions and so exacerbate the greenhouse effect. A carbon tax should attempt to reflect the cumulative external costs.

40. The proposed carbon tax seeks to internalise external costs associated with excessive GHG emissions by adjusting relative prices in order to reflect the social costs of carbon-intensive goods and services. An efficient tax requires that the tax base be as broad as possible, covering as many GHGs and sectors as is practically feasible. In order to allow for a relatively smooth transition to a low-carbon economy, an initial modest effective tax rate to be increased over time is called for.

41. In this context, the government proposes that a carbon tax be introduced at R120 per ton (t) CO_2-eq above the tax-free thresholds (including the proposed offsets) on 1 January 2015. The effective tax rate will be substantially below the rate of R120 per tCO_2-eq (and as adjusted over time) during the first five-year period if the tax-free thresholds are taken into account. However, the R120 per tCO_2-eq will provide an important price signal for mitigation potential on the margin.

42. It is further proposed that the tax rate of R120 per tCO_2-eq be increased at a rate of 10 per cent per annum until 31 December 2019. A revised carbon tax regime with lower tax-free thresholds and a revised tax rate, which should commence on 1 January 2020, should be announced at the time of the Annual Budget in February 2019 at the latest.

International competitiveness and distributional concerns

43. Two key considerations in developing environmentally related taxes are the impact on low-income households and industry competitiveness. The impact of a carbon tax on households is likely to filter through to higher energy prices and electricity, fuel and transport costs. The

extent of the impact on the competitiveness of local firms will be determined by the nature of the goods or services traded; the market structure for the traded goods; and whether the producers are price takers or price setters in the international market.

44. Carbon leakage, which is due to the relocation of firms to jurisdictions without a price on carbon and without a resulting net reduction in global GHG emissions, has been a major concern of countries that have begun to price carbon emissions. Measures to complement the proposed carbon tax policy and address potential adverse impacts on low-income households and industry competitiveness are important. In the design of a carbon tax for South Africa, various relief measures have been considered, including the tax-free thresholds proposed above, and the measures discussed in the section that follows below.

45. One of the potential advantages of making an "early" move to price and tax carbon (to help reduce GHG emissions) is early access to international export markets for low-carbon products. Trade partners may impose carbon constraints through either regulation or market-based mechanisms that result in reduced demand for domestic carbon-intensive goods and services. Some developed countries are considering the introduction of Border Carbon Adjustments (BCAs) where higher import duties are levied on carbon-intensive goods and services originating from countries without an effective GHG mitigation strategy and/or carbon price. Research, development and technology innovation spurred by an effective and stable carbon price could provide essential long-term benefits to assist the transition to a low-carbon economy.

Revenue recycling options – tax shifting and transitional support measures for households and businesses

46. The design of the carbon tax and the economic modelling exercise include various revenue recycling options, such as possible tax shifting (decreasing some taxes), tax incentives, and targeted assistance to households.

47. The government has an important role to play in supporting the transition to a low-carbon economy through targeted programmes and assistance that can help catalyse and smooth the transition for households and businesses. A number of priority flagship programmes have been identified as part of the 2011 White Paper. The programmes are aimed at enhancing South Africa's climate change mitigation and adaptation efforts in the energy, water, transport and waste sectors. Several fiscal support measures for addressing climate change are proposed to complement the set of priority programmes and support South Africa's GHG mitigation strategy. These measures include options to reform existing expenditure programmes and tax incentive measures.

Tax shifting

48. An appropriate balance should be struck between the abovementioned budget support measures, tax incentives and possible tax shifting. Some of these options were considered when the economic impact of a carbon tax was modelled. It might also be that a carbon tax could either delay or even prevent increases in income tax or other taxes as part of an environmental fiscal reform agenda.

Rebates

49. To the extent that the carbon tax will apply to gross emissions as opposed to net emissions, a rebate will apply to carbon capture and storage (CCS). CCS presents technology that could be used to capture CO_2 emissions from coal combustion and gasification processes in South Africa. The CO_2 is compressed, liquefied and transported to a geologically stable site and permanently stored underground. A tax rebate for approved sequestration activities will be considered.

Free basic electricity

50. The provision of support to poor and low-income households to ensure they have access to affordable, safe, reliable and clean energy is important to achieve a smooth, just transition to a low-carbon economy. The government has implemented the Integrated National Electrification Programme (INEP), which seeks to ensure electricity supply to households, schools and clinics.

51. The free basic electricity initiative should be strengthened and an increase in the allocation could be considered. Attempts should be made to harmonise the implementation of the free basic energy programme across the country. The Department of Energy is developing the National Liquefied Petroleum Gas Strategy, which aims to provide access to safe and cleaner alternative fuel for household use.

Energy efficiency and demand-side management

52. The government has implemented the Energy Efficiency and Demand-Side Management (EEDSM) programme, which addresses energy supply security through rolling out specific energy efficiency and renewable energy technologies. The solar water heating framework is primarily aimed at households, whereas the proposed energy efficiency savings tax incentive is aimed at businesses. These measures provide for a deduction against taxable income for verifiable energy efficiency savings and so makes a significant contribution to energy efficiency and, indirectly, to GHG mitigation.

Renewable energy

53. Renewable and cogenerated electricity can contribute to efforts to diversify South Africa's energy mix. The government is committed to promoting clean, renewable energy sources through implementing special tariffs (feed-in tariffs) for renewable electricity generation through a competitive bidding process. Under consideration is a funding mechanism to support the Renewable Energy Independent Power Producer (REIPP) programme, which can also be used as a vehicle to channel international climate funding for renewable energy projects. It is envisaged that this funding will comprise largely concessional loans and target small-scale renewable energy projects (1–5 MW installed capacity). The government is also exploring special tariffs to support cogeneration similar to the renewable energy competitive bidding scheme.

Public transport and the shift of freight from road to rail

54. Emission reductions for the transport sector can be achieved by improving the availability of more energy-efficient modes of freight and public (passenger) transport, and promoting the use of alternative, cleaner fuels. Low-income households spend a large proportion of their incomes

on energy services and transport. The availability of safe and affordable public transportation will therefore provide relief to the poor, and more reliable transport will also encourage a switch from private to public transport by middle income households. In addition, although a significant proportion of South Africa's freight is transported by road, there are initiatives to improve the rail network for freight so as to encourage a shift of freight from road to rail.

The energy sector

55. Pricing energy appropriately is important to ensure that the external costs of climate change and other environmental damages are reflected in the price of energy. The relative prices of carbon-intensive and low-carbon technologies should be reflected correctly.

56. The energy sector's environmental externalities include GHG emissions, as well as local air pollution damages through emissions of sulphur oxides and nitrogen oxides. In the case of the electricity sector, it may be necessary to phase out high emissions-intensive power stations over time and provide support for renewables.

57. Given the regulatory environment of the electricity sector and liquid fuel sector, some consideration must be given to the pass-through mechanism (or lack thereof) for electricity and fuel prices as a result of the carbon tax. This will ensure that appropriate incentives are maintained for changes in both production and consumption patterns.

Existing fuel excise taxes and the electricity levy

58. Excise duties on liquid fuels (petrol and diesel) and electricity generated from non-renewable energy sources serve environmental, demand-side management and revenue objectives. The environmental externalities addressed through fuel taxes are climate change, local air pollution, and those related to road use, such as accidents.

59. Given the current regulatory environment and market structure, the electricity sector is able to pass on the carbon tax to final consumers. Even in this context, it should be noted that the electricity generation sector would not be immune to the impact of the carbon tax. Apart from impacting on future investment decisions, the tax will also reduce the price-cost differentials between fossil fuel-based electricity, nuclear energy and renewable energy.

In the context of an initial relatively low, effective carbon tax rate (taking into account an initial modest rate and the tax-free thresholds), it can be argued that there is unlikely to be any effective double taxation in the foreseeable future. Double taxation may only become an issue if the carbon tax rate is set at a sufficiently high level to fully internalise the external costs associated with carbon emissions. The gradual phasing-down and restructuring of the current electricity levy (energy tax) could be considered as the effective carbon tax is increased over time. Such restructuring should ensure that all large energy intensive users improve their energy efficiency and reduce their emissions, and do not escape the impact and intent of an energy and carbon tax through long-term pricing agreements.

1. Introduction

60. Climate change can be defined as "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods" (UNFCCC, 1992). The Intergovernmental Panel on Climate Change in its fourth assessment report points out to the trend of increasing average temperature of the earth and notes that most of the observed increases in temperature since the mid-20th century are very likely to have been caused by increased greenhouse gas (GHG) emissions resulting from human activities (IPCC, 2007: 72).

61. IPCC also notes that "warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice and rising global average sea level (IPCC, 2007). Warming is expected to be strongest in the Arctic, with the continuing retreat of glaciers, permafrost and sea ice. Other probable effects include increases in the intensity of extreme weather events, the extinction of species, and changes in agricultural yields. Africa, in particular, is expected to come under severe pressure from climate change. The continent's vulnerability is due to its high dependency on the primary sector, declines in crop yields, inadequate irrigation of land, and greater mosquito prevalence, which could lead to an increased incidence of malaria.

62. Climate change is probably the largest environmental problem facing the world today. Urgent action is needed to achieve global commitment in order to limit future warming to below 2 °C above pre-industrial levels. In addressing climate change, countries need to balance their development priorities with efforts to reduce the resource, energy and carbon intensity of their economies. South Africa hosted the 17th Conference of the Parties (COP 17) of the United Nations Framework Convention on Climate Change (UNFCCC) in 2011. During this conference, the country reaffirmed its commitment to voluntarily reduce its GHG emissions to below the business-as-usual trajectory by 34 per cent by 2020, and 42 per cent by 2025. This would be subject to the availability of appropriate financial, technological and capacity-building support.

63. South Africa is ranked among the top 20 countries measured by absolute carbon dioxide (CO_2) emissions, with emissions per capita in the region of 10 metric tons per annum. The government is of the view that South Africa needs to reduce its GHG emissions while working to ensure economic growth, increase employment, and reduce poverty and inequality. At COP 17, President Zuma (South Africa, 2011) reiterated the country's commitment to support efforts dealing with the challenges posed by climate change:

As South Africa, we seek a global regime that ensures that climate change does not reach dangerous levels, while recognising that the priority for developing countries is to address poverty and socioeconomic development. [...] As a responsible global citizen, we remain fully committed to contribute our fair share to the global effort to reduce greenhouse gas emissions. However, given our developmental challenges, we will continue the use of fossil fuels in the short to medium term while transitioning to a low-carbon economy, over the long term. [...] We are forging ahead with our programme of greening the economy to improve the economic, social and environmental resilience of the country in the face of climate change. [...] In promoting this new green, sustainable and inclusive growth focus, we are putting together some policy proposals that will impact on the business sector. These may include putting a price on carbon and other pollution or on the overexploitation of a scarce resource through mechanisms such as taxes, natural resource charges or tradable permit systems. [...] Let me reiterate that we see in the threat of climate change an opportunity to develop our green, inclusive, sustainable and shared growth.

64. The 2011 National Climate Change Response White Paper (henceforth the 2011 White Paper) recognises the role of market-based instruments that create both fiscal incentives and disincentives to support climate change policy objectives (DEA, 2011a: 42). South Africa will employ such instruments as part of a suite of policy interventions to support its transition to a low-carbon economy.

65. South Africa is making progress in ensuring that its economic development is sustainable and particular attention is paid to the way in which economic, social and environmental assets are used. Several environmental problems have been identified and various government departments have developed policy measures to address these concerns, particularly in the areas of climate change, air quality, waste management, and surface and groundwater pollution. It is recognised that good-quality growth is essential to ensure that the country's development is sustainable and its environmental resources remain intact to meet the consumption needs of both present and future generations. These priorities are reflected in the National Framework for Sustainable Development in South Africa (DEA, 2008), as well as the National Strategy for Sustainable Development and Action Plan (DEA, 2011b).

66. It is important that the external costs of GHG emissions that contribute to climate change be appropriately reflected in the final prices of goods and services, particularly energy products. The 2010 discussion paper '*Reducing greenhouse gas emissions: The carbon tax option*' makes the case for a comprehensive carbon price by way of a carbon tax to begin to internalise these external costs (NT, 2010). A phased-in carbon tax will create the necessary price signals and change relative prices so as to encourage behavioural changes in producers and consumers over time. The 2011 White Paper also emphasises, inter alia, the need to price carbon and to consider a carbon budgeting approach to mitigate climate change. It also identifies intervention flagship programmes for renewable energy, energy efficiency, and carbon capture and storage (CCS).

67. During 2011, the National Treasury received and considered 80 sets of comments on the 2010 carbon tax discussion paper from a wide range of organisations, including business, academia, non-governmental organisations (NGOs), and international institutions. It hosted the Carbon Tax Consultation Workshop on 16 March 2011 and engaged with a number of stakeholders during 2011, whose inputs helped to inform and refine the carbon tax design and support measures.

68. The present policy paper provides details of the carbon tax design and revenue recycling options. It elaborates on the design features contained in the 2012 Budget Review and is hereby published for further public comment. Comments on this policy paper should be submitted to Dr. Machingambi at memory.machingambi@treasury.gov.za by 28 June 2013.

2. Policy coherence

69. At the UNFCCC's COP 15 negotiations in 2009, President Zuma of South Africa announced the country's voluntary commitment to reduce its GHG emissions. This commitment is reflected in the Copenhagen Accord, which is a political declaration made by the parties to the Convention and the Kyoto Protocol and provides political direction to international climate change negotiations.

70. Under the Copenhagen Accord, South Africa pledged to undertake nationally appropriate mitigation actions (NAMAs) to ensure that its GHG emissions deviate from the business-as-usual growth trajectory by around 34 per cent by 2020 and 42 per cent by 2025. The Long-Term Mitigation Scenarios (LTMS) report suggests that interventions to mitigate climate change should be informed by, and monitored and measured against, a "peak, plateau and decline" emissions trajectory (ERC, 2007). In such a trajectory, GHG emissions should plateau during 2025–35 and begin declining in absolute terms in 2036.

71. The White Paper (DEA, 2011a: 27) elaborates on this trajectory as follows:

- South Africa's GHG emissions will peak during the period 2020–25, to a range with a lower limit of 398 million tons (Mt) of carbon dioxide equivalent (CO_2-eq) and upper limits of 583 $MtCO_2$-eq and 614 $MtCO_2$-eq for 2020 and 2025 respectively.
- After the peak, the country's GHG emissions will plateau for up to ten years to a range with a lower limit of 398 $MtCO_2$-eq and an upper limit of 614 $MtCO_2$-eq.
- From 2036 onwards, emissions will decline in absolute terms to a range with a lower limit of 212 $MtCO_2$-eq and an upper limit of 428 $MtCO_2$-eq by 2050.

72. The extent to which the pledge would be effectively implemented would depend on a fair, ambitious and effective agreement in the international climate change negotiations under the UNFCCC and Kyoto Protocol, as well as the provision of financial resources, technology transfer and capacity-building support by developed countries.

73. This long-term national emissions trajectory will be used as a benchmark against which the efficacy of the country's mitigation actions will be measured. A carbon tax is just one of the mitigation instruments aimed at moving the country along the path of reducing its GHG emissions. More policy instruments and issues are highlighted below.

2.1 National Climate Change Response White Paper

74. The South African government acknowledges that climate change is a reality caused largely by GHG emissions and concentrations in the atmosphere that are anthropogenic; that is, caused by human activity. The Department of Environmental Affairs (DEA, 2011a) has developed the country's response policy in this regard, which sets the vision for:

- A fair contribution to the global effort to stabilise GHG concentrations
- Effective management of unavoidable impacts through interventions that build and sustain South Africa's social, economic and environmental resilience and emergency response capacity
- A long-term transition to a climate-resilient, low-carbon economy and society.

75. South Africa's approach to mitigating climate change balances its contribution as a responsible global citizen to international efforts to curb global GHG emissions with the country's own economic and social challenges, as well as opportunities presented by the transition to a low-carbon economy. The 2011 White Paper advocates the use of carbon budgeting approach to identify key mitigation measures for significant GHG-emitting sectors and/or subsectors. It also recognises the need for appropriate levels of carbon pricing to facilitate South Africa's transition to a low-carbon future.

2.2 Industrial Policy Action Plan

76. The aim of the Industrial Policy Action Plan (IPAP) is to scale up efforts that promote long-term industrialisation and industrial diversification in South Africa beyond the country's current reliance on traditional commodities and non-tradable services. The IPAP recognises that climate change will have an impact on the country's economic landscape. It notes that, in the export market, "there is a growing threat of increasing 'eco-protectionism' from advanced industrial countries in the form of tariff and non-tariff measures" (DTI, 2010: 41), such as border carbon adjustments and standards that could be viewed as restrictive.

77. The historical capital-intensive, resource-intensive and energy-intensive industrial path is highly likely to become increasingly unsustainable in the future. It will become all the more evident that the manufacturing sector should be more energy efficient. Developments such as these present opportunities for developing new green and energy-efficient industries and related services.

78. The IPAP identifies renewable energy industrial development as one of the green growth potentials that should be explored. In particular, efforts should be directed at expanding the manufacture and installation of solar water heaters (SWHs). This could be enabled through phasing in mandatory requirements to install SWHs instead of electric geysers, and to replace existing electric geysers with SWHs. The automotive sector is also considered in terms of incorporating climate change concerns and technological developments. This is in response to the increasing demand for vehicles with lower GHG emissions, such as electric vehicles and related components.

2.3 New Growth Path

79. *The New Growth Path: The Framework* (EDD, 2010) sets out critical indicators for economic growth and employment creation. It identifies possible changes to the structure and character of production with a view to generating a more inclusive and greener economy over the medium to long term. The Framework also identifies the green economy as offering potential for the creation of new jobs, in particular through utilising technological innovation, expanding existing public employment schemes to protect the environment, and producing renewable energy and biofuels.

2.4 Integrated Resource Plan for Electricity

80. The Integrated Resource Plan (IRP) for Electricity (DoE, 2011) aims at ensuring new electricity generation capacity for the country for the period 2010–30. It estimates the country's long-

term electricity demand and details how this could be met in terms of capacity generation, the type of technology, timing and cost. The Policy-Adjusted IRP was promulgated in May 2011 and provides for the following:

- The inclusion of a full nuclear fleet of 9 600 MW to ensure that sufficient dispatchable base-load capacity is constructed to meet the demand during peak hours and provide acceptable assurance of security of supply
- The maintenance of an emissions constraint of 275 million tons of CO_2 per year from the electricity industry after 2024
- The installation of renewable power sources (solar photovoltaic, concentrating solar power, wind) being brought forward in order to accelerate local industries
- The maintenance of energy efficiency demand-side management (EEDSM) measures at the level of a maximum load of 3 420 MW.

81. Table 2 details the envisaged capacity as per the Policy-Adjusted IRP.

Table 2: Policy-Adjusted IRP capacity, 2010–30

	Total capacity		Capacity added (incl. committed)		New (uncommitted) capacity options	
	MW	**%**	**MW**	**%**	**MW**	**%**
Coal	41 071	45.9	16 383	29.0	6 250	14.7
Open cycle gas turbine (OCGT)	7 330	8.2	4 930	8.7	3 910	9.2
Closed cycle gas turbine (CCGT)	2 370	2.6	2 370	4.2	2 370	5.6
Pumped storage	2 912	3.3	1 332	2.4	0	0.0
Nuclear	11 400	12.7	9 600	17.0	9 600	22.6
Hydro	4 759	5.3	2 659	4.7	2 609	6.1
Wind	9 200	10.3	9 200	16.3	8 400	19.7
Concentrating solar power (CSP)	1 200	1.3	1 200	2.1	1 000	2.4
Photovoltaic (PV)	8 400	9.4	8 400	14.9	8 400	19.7
Other	890	1.0	465	0.8	0	0.0
Total	89 532		56 539		42 539	

Source: DoE (2011: 14, Table 4).

82. The Policy-Adjusted IRP estimated a peak price of R1.12 per kilowatt-hour (kWh) in 2021. After 2028, the technology learning rates on new renewable options should lead to lower costs. Much of the price increase expected up to 2020 is based on the changes to asset valuation inherent in the regulatory rules that the National Energy Regulator of South Africa (Nersa) applies to Eskom's price application, as well as the capital expenditure required in transmission and distribution infrastructure.

2.5 White Paper on the Renewable Energy Policy

83. The White Paper on the Renewable Energy Policy of the Republic of South Africa (DME, 2003b) (henceforth the 2003 White Paper) recognises climate change as one of the major environmental threats facing the world today. For South Africa to be a responsible global

citizen, it needs to reduce its use of fossil fuels through the implementation of renewable energy technologies. However, these technologies often entail higher investment costs than conventional fossil fuels, even though operation and maintenance costs are lower. The lower costs associated with fossil fuels do not fully account for the adverse impact such use has on the environment and on society. The White Paper also recognises that work is required to quantify the level at which these externalities will be priced, as well as how these costs will be incorporated into the decision-making process.

84. The 2003 White Paper acknowledges that internalising these costs may not be sufficient to place the renewable energy sector on a competitive footing with fossil fuels. There will still be a need to support individual renewable technologies in the marketplace until they reach the necessary economies of scale and the required levels of technological development and investor confidence.

85. The Renewable Energy Independent Power Producer (REIPP) programme involves bidding competitively on tariffs for predetermined renewable energy technologies, with a fixed capacity allocation for each technology over five bid windows. The intention is to procure up to 3 725 MW capacity of renewable energy by 2016. The Department of Energy (DoE) will procure electricity from independent power producers (IPPs), with Eskom as the buyer through power purchase agreements (PPAs).

86. During the first bid window, 28 proposals were awarded preferred bidder status, with commitments for the provision of 1 416 MW of renewable energy. In the second bid window, 19 preferred bidders were selected, with commitments for providing 1 042 MW. Table 3 summarises these commitments. There is still a capacity of 1 166 MW available for the remaining bid windows. The DoE estimates that by the end of the bidding process, with its maximum of five bid windows, the IPP programme will have attracted project proposals to the value of R100 billion.

Table 3: Approved renewable energy projects

Type of technology	Net capacity (MW)	Net capacity (%)	Total project cost (ZAR million)	Total project cost (%)	Project cost per net kW (ZAR/kW)
Onshore wind	1 196.5	48.6	23 622	31.9	19.74
Solar PV	1 048.9	42.6	33 988	45.9	32.40
Solar CSP	200.0	8.1	15 848	21.4	79.24
Small hydro	14.3	0.6	631	0.9	44.13
Total	2 459.7	100	74 089	100	30.12

2.6 Energy Efficiency Strategy

87. The Energy Efficiency Strategy of the Republic of South Africa was published by the Department of Minerals and Energy (DME) in 2005 and reviewed in 2008. The Strategy takes its mandate from the 1998 White Paper on the Energy Policy of the Republic of South Africa, which states

the following (DME, 1998: section 3.5.3):

> Significant potential exists for energy efficiency improvements in South Africa. In developing policies to achieve greater efficiency of energy use, government is mindful of the need to overcome shortcomings in energy markets, but without unduly interfering with market forces. Government will create an energy efficiency consciousness and will encourage energy efficiency in commerce and industry. Government will establish energy efficiency norms and standards for commercial buildings and industrial equipment, and voluntary guidelines for the thermal performance of housing.

88. Energy efficiency is recognised as one of the most cost-effective ways of meeting the demands of sustainable development and providing environmental benefits. The Strategy sets a national voluntary target for improving energy efficiency by 12 per cent by 2015. This target is based on the projected national energy demand and economic growth. Sectoral energy efficiency targets have been set as follows:

- Industry and mining sector: 15 per cent
- Power generation sector: 15 per cent
- Commercial and public building sector: 15 per cent
- Residential sector: 10 per cent
- Transport sector: 9 per cent.

89. The Strategy envisages that improvements in energy efficiency will be achieved through implementing enabling instruments and interventions, including economic and legislative measures, information, energy labels, energy performance standards, energy audits, energy management, and the promotion of efficient technologies. In terms of economic instruments, the Strategy acknowledges the need for energy pricing to be based on an assessment of the full economic, social and environmental costs and benefits of policies, plans, programmes and activities of energy production and utilisation.

90. An outcome of the Strategy was the signing of the Energy Efficiency Accord between the DoE and several business associations and individual companies in 2006. The parties to the Accord agreed to cooperate in pursuing national energy efficiency targets on a voluntary basis, recognising that energy usage is a major contributor to GHG emissions in South Africa.

2.7 Energy Security Master Plans and the Integrated Energy Plan

91. The Energy Security Master Plan for Electricity is premised on reaching goals that have been identified for the electricity sector. It sets security of supply standards for the generation and transmission of electricity, and proposes several interventions for achieving the respective adequacy measures (DME, 2007a: 3). The Energy Security Master Plan for Liquid Fuels focuses on developing supply-chain solutions to the challenges the country faces in regard to liquid fuels supply, management of liquid fuels demand, and emergency response tactics (DME, 2007b: 5).

92. The Integrated Energy Plan (IEP) for the Republic of South Africa is a framework within which specific policy and development decisions regarding energy can be made (DME, 2003a). These should recognise the need to balance the requirements of energy supply security and low-cost, affordable and accessible energy with other imperatives, such as environmental and social

development.

93. The IEP recognises that coal remains the dominant primary energy source over the planning horizon, and that coal-based electricity generation is the least-cost option (excluding the cost of externalities). However, the continued use of coal energy presupposes the increased use of clean coal technologies. Although coal remains the largest indigenous energy resource currently available, it is important to diversify energy resources to include other energy forms, such as natural gas and renewable sources of energy. This will improve supply security and environmental performance, and also facilitate regional development.

2.8 National Development Plan

94. In 2011, the National Planning Commission (NPC) held low-carbon workshops involving a wide range of participants from government departments, the private sector, academia and civil society. The aim was to develop a pathway for the transition to a low-carbon economy as part of the country's National Development Plan (NDP). *National Development Plan: Vision for 2030* was published in November 2011. It builds on the LTMS work, with the expectation that South Africa's emissions will follow a peak-plateau-decline trajectory between 2020 and 2035.

95. The NDP recognises key strategies that the government could implement to help stabilise, and then reduce, South Africa's GHG emissions. It requires a commitment to undertake mitigation actions for ensuring a robust and transparent monitoring, reporting and verification system. Strategies include the following:

- An appropriate mix of pricing mechanisms
- An expanded renewable energy programme
- An effective mix of energy efficiency and demand management incentives
- Regulations to promote green buildings and construction practices
- Investment in an efficient public transport system.

96. The NDP argues that actions such as these would need to take place within the context of an agreed international framework for mitigation that imposes an absolute constraint on GHGs internationally during 2030–50.

97. The achievement of a decline in South Africa's GHG emissions from 2035 onwards will require a structural transformation of the economy, which is currently dominated by energy and carbon-intensive activities. It will also involve technological and infrastructural innovation and development. The NDP recognises the need to delink economic activity from environmental degradation and the use of carbon-intensive energy, while remaining competitive and reducing unemployment, poverty and inequality. It guards against locking South Africa's economy into an emission-intensive growth path.

98. The NDP supports the use of a carbon price, through a carbon tax, to contribute to a cost-effective, just and managed transition to a low-carbon economy that would begin to internalise the environmental and social costs of GHG emissions. It recommends a broad-based carbon pricing regime covering all sectors at one consistent price. This will support a non-distortionary and smooth transition package comprising tax incentives and support mechanisms that could be phased out over time.

99. The NDP states that the electricity sector, due to its highly uncompetitive and monopolistic structure (which challenges the effective application of a pricing instrument), may be granted a rebate of the carbon tax. The electricity sector should, in a very transparent manner, be subject to an explicit carbon price equivalent to the costs of avoiding emissions through generating electricity using low-carbon emitting technologies, such as renewable energy sources. Furthermore, an explicit carbon price at an appropriate level would provide an incentive for the efficient use of the current fleet of power stations and thus maximise efficiency gains. This would also allow for the phasing in of low-carbon electricity generation into base-load generation, and the possible phasing out of highly emissions-intensive (coal) base-load power stations in the medium to long term in order to mitigate possible concerns about security of supply.

3. The economics of carbon pricing

100. In a market economy, prices are ideally set in a competitive environment and thus act as important signals for the efficient allocation of scarce resources. This also encourages entrepreneurship and innovation. Markets are said to be "Pareto efficient" if no one can be made better off without making someone else worse off. Where prices are regulated, it is incumbent on the regulator to take into account all variables (cost drivers) that will allow prices to be set close to those that might have emerged in a competitive environment.

101. Such efficiency is not always achieved, however, and free-functioning markets do not always deliver fair outcomes. If markets are left to do their job; that is, making efficient use of the nation's resources, then taxes and transfers can be used to help those whom the market passes by, so that efficient and just outcomes are achieved (Krugman, 2010).

102. In the case of the provision and/or consumption of public goods, price setting "within the market" is not always optimal or fully cost reflective. This is because public goods are often not appropriately priced and have non-rival and non-excludable characteristics. *Non-rivalry* implies that the use of the goods or services by one person does not diminish the amount of those goods or services available to the next person, while *non-excludability* implies that consumption of, or payment for, the provision of goods or services by one person does not exclude non-payers from enjoying those goods or services. Most natural resources or environmental goods have the same characteristics as public goods (such as water, air, national defence, etc.). The non-rival and non-excludable characteristics of public goods lead to externalities in their provision or consumption.

103. Externalities refer to situations where the effect of the production and/or consumption of goods and services imposes costs or benefits on third parties which are not reflected in the prices charged for those goods and services:

- *Positive externalities* imply that society at large gains due to the action of a few, and the net result is that too little of the product will be produced at relatively high prices.
- *Negative externalities* imply that society is impacted adversely as a result of the actions of a few, and too much of such a product is likely to be produced at relatively low prices. Water pollution and local air pollution are examples of negative externalities that can be addressed through regulations and/or taxes. Because water pollution and air pollution are very visible and impact directly on the quality of life of the local population, there is general consensus that appropriate actions should be taken to deal with these undesirable outcomes. In doing so, the costs incurred are carried either by the producers or the consumers, or both. Where producers can, they pass onto the consumers some or all of the costs incurred to clean up the pollution.

104. The presence of externalities implies market failure. It is then appropriate for governments to intervene in the market in order to influence producer and consumer choice or decision making in a way that would result in a better outcome for society as a whole. Historically, environmental policies of most governments were dominated by regulatory instruments, such as standards, bans on the use of certain goods and technologies, liability payments (e.g. mining rehabilitation funds) and non-tradable permit systems, which are permits (e.g. fishing quotas) issued to manage natural resources at a sustainable level.

105. In most instances, regulatory measures such as these require all firms to comply with a specific

regulation, regardless of the resulting costs to individual firms. Standards also tend to limit the incentive to undertake investment – the firms have little reason to go beyond compliance with the regulation, as this could lead to stricter regulations for them in future. Setting up an appropriate regulatory regime requires detailed information of a firm's abatement costs, which it may be reluctant to disclose. A market-based instrument, on the other hand, sets a price on the unpriced element or externality that causes the initial market distortion. This ensures that the polluter must always take environmental costs into account when making decisions. Excessive GHG emissions contribute to climate change and are therefore viewed as a negative externality.

106. In this context, the case for a carbon price has been made by numerous experts:
Without a coherent framework for pricing greenhouse gas emissions, American companies have been unable to make rational decisions about investments that carry significant energy implications, such as spending on factories, equipment, and product design. [...] Price signals give companies a clear incentive to change their behavior and to invest in new technologies that avoid environmental harm. Therefore, we propose an emissions charge that would directly attack damaging market failures and spur clean-energy innovations. Emissions charges are administratively straightforward and transparent. Subsidies, by contrast, are hard to deploy productively and are often subject to political influence. [...] We propose that the charge be levied at the first point of sale of a fossil fuel – that is, coal, oil, and gas companies would pay on the basis of the carbon content of the fuel they deliver. [...] Even China has announced plans for pricing carbon emissions. A slow but steady escalation from a very low base would minimize the initial economic burden while changing investment behaviour immediately (Esty & Charnovitz, 2012).

[C]arbon pricing should ideally form the centrepiece of mitigation efforts. [...] Carbon pricing also strikes the cost-effective balance between different emissions reduction opportunities because all behavioral responses are encouraged up to where the cost of the last tonne reduced equals the emissions price. Moreover, the carbon price provides a strong signal for innovations to improve energy efficiency and reduce the costs of zero- or low-carbon technologies. By definition, regulatory policies on their own, like mandates for renewable fuel generation and energy efficiency standards are far less effective as they focus on a much narrower range of emissions reduction opportunities. [...] A reasonable minimum price to aim for seems to be around US$20 per tonne, under either least-cost climate stabilization or damage valuation approaches. Establishing a credible time path for progressively rising carbon prices is also important to create stable incentives for long-term, clean energy investments (De Mooij et al., 2012).

[T]he only way to get people to change their behavior appropriately is to put a price on emissions so this cost in turn gets incorporated into everything else in a way that reflects ultimate environmental impacts. [...] When electric utilities have to choose among energy sources, they will have to take into account the higher license fees or taxes associated with fossil fuel consumption. And so on down the line. A market-based system would create decentralized incentives to do the right thing, and that's the only way it can be done (Krugman, 2012).

3.1 Transition to a low-carbon economy

107. Carbon pricing will encourage a shift in production patterns towards low-carbon and more energy-efficient technologies. It will change the relative prices of goods and services and make carbon-intensive processes and products more expensive. Carbon capture and storage

technologies will only be implemented when conventional carbon-intensive technologies and processes are confronted with the associated environmental damages through a carbon price.

108. As low-carbon technologies become commercially viable and therefore profitable, they will help to focus the attention of decision makers on opportunities arising from implementing energy efficiency or direct carbon abatement measures. Carbon pricing will also help to enhance the effectiveness of regulations, such as targeted policies for improvements in energy efficiency. Regulatory measures to encourage energy efficiency improvements and savings in households through the uptake of energy-efficient lighting and heating measures could result in the rebound effect. (For example, owners may become negligent in not turning off lights when they are not in use, and so eliminate the benefits gained from implementing energy efficiency measures.) A carbon price could reduce the potential rebound effect resulting from these savings, and help to maintain the overall incentive for using energy efficiently.

109. Achieving meaningful reductions in emissions will require that all economic sectors and industries contribute through technology and efficiency improvements. This may mean the consumption of certain carbon-intensive products, such as cement, steel and aluminium, could be reduced. This may be achieved either by using products more efficiently or by substituting them with other materials. Another possible outcome of an effective carbon price is the potential for change in the electricity generation mix, and a reduction in the quantity of electricity generated by conventional coal-fired power stations.

110. The imposition of a carbon price could encourage substitution at all stages along the production value chain. In the cement manufacturing process, for instance, clinker is produced by heating limestone, and the chemical transformation that follows results in carbon emissions. Emissions from the heating process can be reduced by using renewable energy sources. However, the majority of the emissions emanates from the chemical transformation taking place, which is largely unavoidable. The clinker is then milled and mixed with other substances to produce cement. An option to reduce the carbon emissions would be to replace some of the clinker with other materials that are suitable for cement production. Furthermore, the cement that is then used for concrete manufacture and construction could be substituted with other materials, such as steel, wood, stone or glass. To the extent that the prices of concrete, steel and glass reflect the costs of the carbon emissions, an incentive is created for consumers to change their choice of inputs.

111. Investors may also be faced with the choice of either renovating existing buildings or replacing them with new ones. If the price of carbon emissions is reflected in the prices of materials, it would create an incentive to refurbish buildings rather than replace them. In other instances, there may be a case for replacing a building due to its inherent structural inefficiencies. A greener architectural design for such a building may be costly in the short term, but would result in broader, longer-term environmental and financial benefits.

112. The implementation of a carbon price will create incentives for research and development (R&D) and technology innovation in lower-carbon technologies, products and services. The achievement of a reduction in emissions in the long term will be attributable to such improvements in technology and innovation. However, these newer, energy-efficient or renewable technologies are likely to be more expensive than established conventional technologies. Such costs should drop as producers become more experienced in producing these technologies and optimise the design and production process, and as users integrate these technologies into existing infrastructure.

113. An effective carbon price that increases the costs of more conventional, carbon-intensive technologies will support this learning-by-doing process as follows:

- It will reduce the cost gap that companies or public subsidies have to cover while the costs of new technologies still exceed those of conventional technologies.
- New technologies will become cost competitive with conventional technologies sooner, thus reducing the time over which learning investment occurs.
- The profitability of new technologies will be higher in the future as they compete against a more expensive conventional technology. This is likely to stimulate private sector interest in the R&D for, and commercialisation of, these technologies.

114. Effective policy interventions suggest that the government should not pick “winners”; that is, specific low-carbon technologies qualifying for public support. A carbon price intervenes in a technologically neutral manner without requiring the government to decide which specific technologies to support. However, a carbon price in isolation is unlikely to be sufficient to stimulate the high levels of investment in R&D and technology innovation that are required. Private sector investors currently under-invest in innovation, as they do not capture the full benefit of their innovation. Accordingly, several countries (including South Africa) have implemented complementary tax incentives for R&D and demonstration activities in order to compensate companies for the uncertainties of such investments and for the spill-over of ideas and intellectual property rights among companies (they are examples of positive externalities).

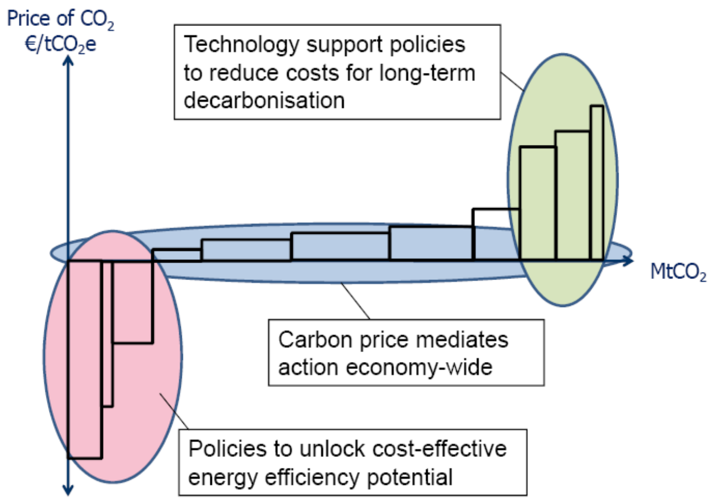
115. The private sector has delivered innovation in sectors such as telecommunications and the motor vehicle industry, and should be able to replicate similar initiatives in other sectors. The heterogeneous nature of these products makes it possible for companies to develop niche markets and to charge a premium in order to finance further innovation. However, in the energy sector (which is the largest contributor to carbon emissions), the homogeneous, undifferentiated nature of the product and the natural monopolistic structure of the market for energy products make it either unlikely or difficult for companies and suppliers of these technologies to agree on large-scale learning investments when the exact nature of the final technology is unclear.

3.2 The core policy mix

116. The core policy mix to mitigate climate change constitutes a carbon pricing mechanism, energy efficiency policies and technology policies (Figure 1). Regulatory mechanisms, such as the IRP, or pricing mechanisms on their own, may fail to adequately incentivise least-cost decarbonisation; hence the need for their complementary use on the path to a low-carbon, climate-resilient economy.

Figure 1: The core policy mix to mitigate climate change

Source: IEA (2011: 8).



117. Carbon pricing plays an important role in incentivising innovation and encouraging the diffusion and uptake of more energy-efficient and low-carbon technologies. It provides the necessary long-term policy certainty and credible price signals for mitigation actions, coupled with appropriately targeted support schemes to further stimulate private sector investment in R&D and technology innovation (Neuhoff, 2008).

118. An appropriate carbon tax rate should, in principle, reflect the marginal external damage costs of carbon emissions; however, these costs are difficult to estimate. The risk or fear of carbon leakage, in the absence of an international carbon price, may also influence the effective level of a domestic carbon tax. Climate change brings about external costs that comprise both the cost of tangible damage and the cost to mitigate and adapt to new circumstances. Quantifying marginal external costs of carbon emissions therefore follows two main approaches:

- Marginal damage estimates, which involve the direct valuation of the costs of climate change and include assumptions on the expected degree of damage, climate risks and the frequency of extreme events
- Cost effectiveness, which entails an indirect valuation of carbon emissions, quantifying the cost-price trajectory needed to achieve a specific target for climate stabilisation at the least cost.

119. Estimates for carbon prices range from roughly US$8 to more than US$300 over the long run. These estimates take into account a number of issues, including:

- A specific emissions reduction path or stabilisation target
- Whether calculations of estimates include damages of the current stock of emissions only, or also factor in future growth in emissions
- The level of the discount rate used to value the costs of damages that will be imposed on future generations.

120. The adoption of a stricter target for GHG emissions concentrations will bring about a higher carbon price. The Stern Review (2006) argues that policy interventions should seek to stabilise

emissions to a maximum of 550 parts per million (ppm) CO_2-eq, and suggests that a global CO_2 price of US$30 per tCO_2 would be needed to achieve this target.

121. A carbon price could be introduced in the form of either a carbon tax or an emissions trading scheme whereby all emissions allowances are auctioned. This would also provide a revenue stream for the government that could be "recycled" to finance transitional support measures and general government expenditure, or reduce distortive taxes, such as payroll taxes. Such recycling of revenues could help to improve the efficiency of the carbon pricing instrument in managing the transition to a low-carbon economy. The introduction of a carbon tax could potentially create the double benefit of reducing emissions and creating employment if taxes on labour are either reduced or not increased (if such an increased tax on labour were deemed necessary to raise additional revenue).

122. Where the benefits of innovation are not easy to appropriate, targeted support schemes will be an important complementary policy intervention to the carbon pricing policy. The government should therefore provide assistance for technological innovation where:

- There is transparent and public information about the technologies and their potential.
- The government retains its institutional independence to abandon these support programmes should the technology not meet the desired expectations.
- Private sector firms are unlikely to extract the full benefit of the future innovation and are thus not in a position to finance the learning investment.

123. Several countries have implemented complementary policies to support the development of low-carbon technologies and facilitate the transition to a low-carbon economy. A key policy intervention is feed-in-tariff policies for renewable energy, which seek to create a market for technologies that are not yet cost competitive compared with conventional technologies. Typically, these policies aim to support the diffusion of the technologies. They also seek to eliminate possible institutional and regulatory barriers; accelerate learning associated with low-carbon technologies; and contribute to the low-carbon and energy security of supply objectives.

4. A carbon tax versus an emissions trading system

124. According to economic theory, over time an emissions trading system (ETS) and a carbon tax will give the same environmental results and carbon prices. Over the short to medium term, a carbon tax provides price certainty but no absolute cap or limit on emissions. An ETS, however, imposes a quantitative restriction; hence it gives certainty about the quantity of the anticipated reductions in emissions.

125. In order to realise the full benefits of an ETS, emissions allowances should be auctioned rather than allocated for free. In the case of the EU ETS, free allocation of allowances (and subsequent over-allocation of allowances) resulted in low and very volatile carbon prices. Indeed, EU ETS permit prices fell by around 70 per cent from July 2009 to February 2010 (UNEP, 2010: 19). As part of the design of these instruments, free allowance allocations should be phased out and broad sectoral coverage should be targeted in order to limit carbon price uncertainty. It is argued that a carbon tax will provide the necessary price certainty to encourage investments in new technologies, as opposed to instances where the carbon price may either fluctuate widely or drop to very low levels for long periods of time.

126. An ETS needs a certain number of traders and sufficient trading volumes for the market to operate efficiently. The oligopolistic market structure of the energy sector in South Africa may fail to meet these requirements which make the market very "thin". Thus the lack of a viable number of industry players with diverse abatement costs is likely to limit the opportunities for domestic trade in a purely South African trading scheme.

127. An ETS is rather administratively complex and involves relatively high transaction costs. There is a need for an adequate institutional framework and oversight body to ensure transparency. An ETS requires new systems to administer emissions baselines, allocate emissions rights, and verify and enforce compliance. A market platform for trading must be established, and there needs to be appropriate institutional capacity for the auctioning of permits and possible development of rules for the free allocation of permits. This is clearly an administrative challenge and will take time to develop. Considerable administrative constraints will be prevented if the proposed carbon tax is implemented using much of the existing tax administrative machinery. A carbon tax therefore seems a more suitable measure to facilitate South Africa's transition to a low-carbon economy.

128. A case is also made for implementing a global carbon tax over an ETS in order to incentivise consumers and companies, not governments, to pursue innovation (Martin & Kemper, 2012):

> The biggest challenge for innovation in energy is [the] substantial vacillation in the price of oil, which discourages large-scale investment in substitutes. The carbon offset pricing featured in cap-and-trade programs, which does nothing to dampen profitability swings for alternative technologies, is therefore not the answer. Far preferable would be a variable gap-filling carbon tax to preserve a floor price for a barrel of oil.

129. The government proposes a gradual phasing in of the carbon tax, with significant relief measures during an initial five-year transition period. In line with the 2011 White Paper, the government will investigate the feasibility of an ETS to complement – and not replace – the proposed carbon tax by around 2025 or sooner, if practically possible. This would allow for

possible integration into an internationally agreed carbon pricing regime. (As stated in section 5 below, only about 45 per cent of European GHG emissions are currently covered by the EU ETS; most of the remaining GHG emissions are subject to a carbon or energy tax.)

5. International carbon price developments

130. Internationally, reductions in GHG emissions have been achieved by a combination of ETSs, carbon taxes and other complementary regulatory policies. Different countries have implemented various mixes of policies to curb their GHG emissions. (See Annexure B for more details.)

5.1 Europe

131. The EU ETS is said to cover about 45 per cent of GHG emissions in Europe. Sectors or activities not covered by the scheme should, in principle, be dealt with through carbon or energy taxes. There is a close link between energy taxes and carbon taxes, and many European countries have reformed (or are reforming) these taxes to include a specific carbon element to complement the EU ETS.

132. Policy initiatives are underway to extend, introduce or increase coverage by carbon tax rates in those sectors not covered by the scheme. Carbon taxes in European countries were gradually phased in, starting at low rates with rebates for sensitive industries. Over time, incremental increases in the rate were introduced to enhance political acceptability, provide price certainty, and allow firms time to adjust. Structured, automatic adjustments send a clear price signal for long-term investment decisions and encourage behavioural responses, even at initial low tax rates. A strict and consistent application of the carbon tax would make the tax applicable to fuels according to their carbon content, such that carbon-intensive energy products (e.g. coal) would be taxed at a higher rate than less carbon-intensive fuels (e.g. natural gas). The average tax rate applied to fossil fuels varies across jurisdictions:

- Carbon taxes are highest in Sweden (US$41 per tCO2), which applies a system of progressive reductions in initial exemptions.
- Denmark also applies a system of progressive exemptions reductions and grants a 50 per cent refund on the tax applied to the use of steam coal by industry. Households are subjected to the full carbon tax.
- Finland introduced a carbon tax in 1990 at a modest level of US$1.4 per tCO2 and increased the rate over time.
- France's carbon tax on fossil fuel in the form of a specific levy was proposed in 2009 at a rate of €17 per tCO2 and applied to gasoline, diesel fuel, coal and natural gas. However, the French Constitutional Council felt that the extensive compensatory measures of the proposed tax did not promote equality among taxpayers and would defeat the intention to promote environmentally friendly behaviour and reduce carbon emissions. The Council therefore rejected the proposed provisions.
- Ireland introduced a carbon tax in 2010 to complement the EU ETS. The carbon tax aims at capturing emissions not covered by the EU ETS and thus includes mainly transport, waste and heat in buildings. The initial carbon tax rate, applied in 2010 and 2011, was set at €15 per tCO2 and was subsequently increased to €20 in 2012.

133. Revenue recycling in the EU has been accomplished through tax shifting by imposing taxes on "bads" (e.g. pollution) and reducing taxes on "goods" (e.g. labour income). It thus yields the

double benefit of creating a more efficient tax system and encouraging environmental protection.

5.2 Canada – British Columbia

134. In July 2008, the government of British Columbia introduced a carbon tax on emissions generated by burning fossil fuels (gasoline, diesel, natural gas, fuel oil, propane and coal), as well as emissions linked to non-commercial activities. Exemptions include all emissions not falling within the scope of the carbon tax and involve non-energy agricultural uses, fugitive industrial processes, solid waste disposal, fuel exports, and inter-jurisdictional commercial marine and aviation fuels. The tax rate started at CAD10 per tCO_2 in 2008, increasing by CAD5 per tCO_2 annually to CAD30 per tCO_2 in 2012. Carbon tax revenues are recycled through a refundable tax credit and reductions in personal and corporate income tax rates.

5.3 Canada – Alberta

135. Alberta is responsible for one third of Canada's total volume of GHG emissions, amounting to, approximately, 233 million tCO_2-eq in 2010. Its GHG emissions derive mainly from oil sands production, coal mining, oil and gas production, electricity generation (primarily from coal), and transportation. The province introduced a baseline and credit ETS in July 2007 that covers approximately 100 sites emitting over 100 000 tCO_2-eq per annum. The programme requires a 12 per cent reduction in emissions intensity relative to the baseline emissions intensity, and allows for further tightening in the future.

136. The available compliance mechanisms include onsite emission reductions; purchase of bankable emission performance credits (EPCs) for facilities emitting over the stipulated 12 per cent intensity reduction; purchase of Alberta-based offsets; and contributions to the Climate Change and Emissions Management Fund (CCEMF) at a rate of CAD15 per tCO_2-eq. This contribution rate also serves as a cap on the cost of compliance for regulated facilities, and sponsors solicitations for projects dealing with energy efficiency, clean and renewable energy, and carbon capture and storage.

137. The most popular compliance option has been the Technology Fund, with approximately 21 $MtCO_2$-eq of emission reductions. Offsets provided nearly 17 Mt in 2011, while EPC credits accounted for 5 Mt. The Alberta government now recognises 31 approved offset protocols or project types, such as improved tillage practices in the agricultural sector, wind and biomass energy, hydropower, landfill gas abatement, energy efficiency, enhanced oil recovery, wastewater management, and nitric acid abatement.

5.4 China

138. The twelfth Five-Year Plan (for 2011–15) of the People's Republic of China focuses on high-quality growth and environmental protection. Specific targets include increasing non-fossil fuel use to 11.4 per cent of the total energy use by 2015 and to 15 per cent by 2020, as well as achieving a 16 per cent reduction in energy use per unit of gross domestic product (GDP) by 2015, and a 17 per cent reduction in CO_2 emissions per unit of GDP by 2015. The government is also considering introducing carbon pricing through a carbon tax and trading scheme by 2013

(KPMG, 2011). China's draft Plan for National Economic and Social Development (PRC, 2011) proposes limits on energy consumption per unit of production; pilot cap-and-trade programmes; afforestation of 6 million hectares (ha) of land; market-based reform of prices for resource products; environmental protection charges; refined petroleum products; an improved pricing mechanism for natural gas, nuclear power, hydropower and power from other renewable energy sources; an accounting system for GHG emissions; and the expansion of low-carbon trials.

5.5 India

139. The government of India has prioritised key sectors (including electricity, transport, oil and gas, industry, buildings and forestry) in its road map for low-carbon development to support inclusive growth and reduce the emissions intensity of its economy. On 1 July 2010, the government implemented an excise tax ("carbon tax") on coal at the rate of INR50 (about US$1) per ton of coal. This coal tax applies to both domestically produced and imported coal, and revenues are used to finance the National Clean Energy Fund (NCEF) and research in clean energy technologies and environmental programmes. An energy intensity-based trading scheme – the Perform, Achieve and Trade (PAT) mechanism for energy efficiency – was approved to establish mandatory energy efficiency targets for energy-intensive installations and electricity producers.

140. Facilities that achieve savings above their mandated reductions are issued with energy saving certificates (ESCerts) for savings in excess of the target. ESCerts can be traded with facilities that fail to meet compliance targets. Thus the PAT allows for cost-effective improvements in energy efficiency across sectors. It aims for comprehensive coverage of about 700 facilities in India, and is expected to achieve cuts in carbon emissions of around 25 million tons per year by 2014–15. Under India's National Action Plan on Climate Change (NAPCC, 2008), eight national missions have been approved and involve solar initiatives, enhanced energy efficiency, sustainable habitats, water, the Himalayan ecosystem, a green India, sustainable agriculture, and strategic knowledge for climate change.

5.6 Australia

141. Australia's carbon pricing regime, which came into effect on 1 July 2012, will use a fixed carbon price similar to a tax for the first three years, before moving on to an ETS as from 1 July 2015. The carbon price commenced at a rate of AUD23 per ton and will increase by 2.5 per cent annually. The scheme applies to about 500 of the country's largest polluters and covers all stationary Scope 1 emissions from specific facilities, four main GHGs (carbon dioxide, methane, perfluorocarbons and nitrous oxide), electricity generation, transport, industrial processes, fugitive emissions and certain waste-related emissions sectors.

142. Assistance is provided to sectors to help them manage the transition to a low-carbon future, while taking account of their trade exposure and the emissions intensities of their activities. Entities can use offsets up to a maximum of 5 per cent of their carbon tax obligation under the scheme. Complementary assistance programmes to support jobs, households, businesses and communities in order to protect international competitiveness will be implemented.

5.7 Costa Rica

143. The National Strategy on Climate Change (ENCC) is an integrated, long-term sustainable development plan that aligns Costa Rica's strategies for climate change and economic competitiveness. In 1997, the country enacted a tax on carbon pollution, set at 3.5 per cent of the market value of fossil fuels. The revenue generated by the tax goes toward the Payment for Environmental Services (PSA) programme, which offers incentives to property owners to practise sustainable development and forest conservation. There is also a tax on water pollution that penalises homes and businesses for dumping sewage, agricultural chemicals and other pollutants into waterways.

144. In 2007, the country announced its pledge to become carbon neutral by 2021, and central to this goal is the design and operation of a voluntary domestic carbon market. The five priority sectors participating in this market that will supply the required offsets are energy, transportation, agriculture, solid waste management, and sustainable construction.

5.8 Mexico

145. Mexico is undertaking ambitious mitigation actions to comply with the mid-term mitigation target of reducing up to 30 per cent of its GHG emissions by 2020 and 50 per cent by 2050, as committed at COP 15. The country passed climate change legislation with legally binding emission goals in April 2012. This created a framework allowing the government to earmark budgets dealing with climate change, and create new investments for climate mitigation and adaptation. Carbon markets are the preferred tool for promoting actions to reduce GHG emissions and support the development of a low-carbon economy.

146. The new institutional architecture, including the measurement, reporting and verification (MRV) system, the NAMA office, the NAMA registry/tracking system and Climate Change Fund, among others, is expected to lay the foundation for the fast implementation of a national ETS. The ETS will include international transactions with countries with which Mexico enters into an emissions trading agreement. The main goal is to increase the use of renewable energy through developing a system of incentives, so that by 2024, 35 per cent of the electricity generated will be from renewable sources.

147. To summarise, many countries are committed to the international processes under the UNFCCC to support a globally coordinated response to climate change. However, the slow progress made in achieving an internationally binding agreement on effective mitigation and adaptation measures has driven the development of various national policy initiatives in anticipation of, and preparation for, a future global agreement. Carbon pricing remains a central part of countries' policy strategies for mitigating against climate change, and different versions of carbon taxes, ETSs and hybrids of the various instruments are being implemented.

6. Modelling the economic impacts of a carbon tax

148. Several studies have been undertaken to model the broad macroeconomic impacts of carbon pricing in South Africa. These include work done by the University of Pretoria (Van Heerden et al., 2006), the World Bank (Devarajan et al., 2009), the University of Cape Town (Pauw, 2007; Kearney, 2008) and the National Treasury (Alton et al., 2012); also see Annexure A. The modelling exercises demonstrate that the imposition of a carbon tax will bring about a considerable reduction in carbon emissions. The impact of a carbon tax on the country's economic output, however, is shown to be largely neutral, depending on the revenue recycling measures used to mitigate potential negative impacts on the economy.

6.1 UNU-WIDER and National Treasury model

149. The National Treasury's model was developed in collaboration with the United Nations University–World Institute for Development Economics Research (UNU-WIDER) as part of a broader initiative for climate change and development capacity building. A dynamic computable general equilibrium (CGE) model (Arndt et al., 2011) for South Africa was used and solved for the period 2010–35. The model captures the complex interactions between producers and consumers, and between domestic and foreign economies. As part of the carbon tax consultation process, several discussions were held with stakeholders to clarify the assumptions and results from the National Treasury's carbon tax modelling exercise.

150. A sensitivity analysis was carried out and the impact modelled of a R100 and a R200 per tCO_2 carbon tax gradually implemented over a period of 10 years. The tax was imposed upstream, based on the emissions intensities of fossil fuel inputs. A number of recycling options were investigated, including recycling through reductions in corporate income tax (CIT), personal income tax (PIT) and value-added tax (VAT); increased transfers to households; and higher levels of government investment. An attempt was also made to measure the effect of the carbon tax on the economy in the presence of retaliatory tariffs and the improved affordability and availability of greener technologies. In particular, impacts on the following were evaluated:

- Emission reductions
- The performance or competitiveness of the different economic sectors
- Employment and investment
- Income inequality
- Overall output.

151. The baseline scenario in the model presents the business-as-usual case and a number of different assumptions feed into the baseline, which is centred on the revised balanced scenario of the 2010 Integrated Resource Plan (IRP2). Overall, economic growth is expected to be around 4 per cent, with the mining and manufacturing sectors growing at an average of 4.6 and 4.3 per cent, respectively. The baseline does not include any new tax increases that could result from the implementation of the proposed national health insurance and social security reforms.

152. It is important to note that while reductions in carbon emissions have been estimated, no value has been attributed to the benefits accruing to South Africa from the lower levels of domestic pollution or risks arising from global climate change. The latter aspect could be justified by

South Africa's position as a "climate change taker" – while the country will internalise the negative externalities associated with its GHG emissions, it will be unable to capture benefits. That is, unless the rest of the world also mitigates against GHG emissions, or South Africa is able to capture the benefits conferred on other global players through either carbon trading schemes or other international measures. Although the country's carbon tax will lead to less domestic pollution and so have a positive impact on the local environment, it will not prevent or minimise climate change impacts and the associated adaptation costs. Only global mitigation efforts will have a significant impact on climate change. Therefore, to the extent that reduced levels of carbon emissions (which could be expected as an outcome of various reduction initiatives) have direct or indirect domestic benefits, the reported results either overstate the costs or understate the benefits of a domestic carbon tax.

153. The modelling results indicate that a carbon tax implemented gradually and complemented by effective revenue recycling will reduce GHG emissions. It will facilitate the country's transition to a greener economy and have a largely neutral impact on economic growth, employment and income inequality. These results are generally in line with studies on the economic impact of introducing a carbon tax in different countries. Moreover, the impact of a carbon tax will depend on how trade, industrial and energy policy facilitates the transition to a carbon-resilient economy. In the presence of a carbon tax, trade and industrial measures that decrease the affordability and availability of green technology will raise the adjustment costs of firms and consumers.

154. Table 4 outlines the results for the R100 per tCO_2 scenario. The impact of the carbon tax on the South African economy is presented while assuming different recycling options. The introduction of a carbon tax penalises activities with relatively high carbon intensities and encourages the reduction of GHG emissions. Because the relative costs of carbon-intensive industries are higher compared with less carbon-intensive sectors, prices of the so-called dirty goods and services also rise. The tax shifts production and consumption decisions away from environmentally unfriendly goods and services towards cleaner activities. As cleaner technologies become relatively cheaper, firms and households will become more likely to implement them. This encourages greater investment in the development of greener technologies, such as carbon capture and solar energy.

155. A gradually introduced carbon tax of R100 per tCO_2 is likely to have a small impact on output, which varies between –0.14 and 0.54 of the GDP in 2035, depending on the recycling option. This impact is less than 10 basis points in terms of annual growth. The primary sector, in particular mining, is affected the most, which reflects the large electricity intensity of the sector. (Note that the choice of recycling options is guided by policy considerations, but also by the properties of the model. The model cannot evaluate recycling options that have a complex institutional setup, but may be more effective than the presented options.)

Table 4: Economic impacts of a carbon tax of R100 per tCO_2

Gradual implementation of a R100 carbon tax
Deviation from the baseline by 2035 (%)

RECYCLING OPTIONS	
VAT	-0.14
Primary	*-1.55*
Manufacturing	*-0.57*
Services	*0.25*
CIT	-0.30
Primary	*-2.25*
Manufacturing	*-1.73*
Services	*0.53*
PIT	-0.27
Primary	*-1.67*
Manufacturing	*-1.04*
Services	*0.16*
TRANSFERS	-0.25
Primary	*-1.31*
Manufacturing	*-0.81*
Services	*0.12*
INVESTMENT	0.54
Primary	*-0.05*
Manufacturing	*0.16*
Services	*0.77*
ALTERNATIVE SCENARIOS - VAT	
HIGHER ABILITY TO ADJUST	-0.08
Primary	*-2.40*
Manufacturing	*-0.47*
Services	*0.45*
MORE EXPENSIVE TECHNOLOGY INPUTS (5%)	-0.53
Primary	*-6.60*
Manufacturing	*0.22*
Services	*0.26*
RETALIATORY TAX ON SA EXPORTS (US$30)	0.95
Primary	*-0.73*
Manufacturing	*1.36*
Services	*1.09*

DETAILED VAT SCENARIO	
TOTAL GDP	**-0.14**
Primary	-1.55
Agriculture	0.93
Mining	-2.28
Manufacturing	-0.57
Food	0.73
Textiles	1.84
Wood, paper & plastic	0.32
Petroleum	-15.99
Chemical	-1.12
Non-metal	*0.07*
Metal	*2.50*
Machinery	0.81
Vehicles	*3.25*
Other	*2.27*
Electricity	*0.00*
Water	*-0.59*
Construction	*-0.57*
Services	0.25
Wholesale and retail trade	*0.59*
Transport and communication	*0.01*
Financial and insurance	*0.29*
Business	*0.23*
Government	*0.14*
Other	*0.25*
FACTOR DEMAND	
Labour	-0.01
Primary	*-0.06*
Matric	*0.01*
Secondary	*0.00*
Tertiary	*0.00*
Capital	0.07

156. Low electricity prices, along with other industrial policies, have favoured dirty industries and do not take environmental costs into account. This has brought about considerable misallocation of capital and encourages the use of carbon-intensive technologies. The carbon tax affects these industries disproportionately by correcting previous misallocations and raising their costs relative to those of other greener industries. The higher costs are partially offset by recycling the additional revenue through a reduction in either CIT, PIT or VAT. In the manufacturing sector, the petroleum industry is affected the most. This reflects the extent of South Africa's use of coal in liquid technologies to produce synthetic fuels. In the absence of a border tax adjustment for petroleum products, the drop in domestic supply is offset by imports. The slowdown in certain economic sectors should be seen as a necessary change in the composition of the economy in order to achieve greener growth and greater reductions in emissions.

157. The impact of the carbon tax on employment occurs through the change in sector output and compositions. Labour-intensive sectors will benefit from the tax, as they generally tend to be

cleaner industries. The shortage of skilled labour will exacerbate the negative impacts on employment in that it limits the ability of the economy to expand.

158. The results suggest that a carbon tax in South Africa is not necessarily regressive, as the tax affects mainly capital and energy-intensive sectors. The rents from these sectors accrue to the top deciles of income distribution. The carbon tax has a small, progressive impact and reduces inequality marginally. This moderation in inequality is slightly stronger when the revenue is recycled through transfers to households. Because poor households may face higher electricity and transport prices, measures should be put in place to protect these vulnerable groups.

159. The availability and affordability of alternative technologies are essential to putting the economy on a greener growth path. The government needs to ensure that firms and households have access to alternative greener technologies, and that these are absorbed. Improvement in the availability and affordability of alternative technologies, as well as structural reforms to enhance the ability of the economy to make the transition to a greener economy, should be implemented in tandem with the carbon tax.

160. The debate on global climate change indicates that trade measures might be used against countries not mitigating against GHG emissions and taking a free ride on efforts of other countries instead, thus leading to carbon leakage (that is, the displacement of emissions from one country to another due to the relocation of industry). These trade measures could include a retaliatory tax on exports of non-mitigating countries, or other sanctions. Even if sanctions are not imposed, it is possible that consumers among South Africa's major trade partners will shift their consumption towards goods and services produced using environmentally friendly methods. In both cases, the result will be a decrease in demand for South African exports. Imposing a carbon tax will help to ensure that South Africa's exports are less carbon intensive, thus avoiding retaliatory trade and consumer actions.

161. The introduction of a carbon tax is expected to lead to positive gains equivalent to almost 1 per cent of the GDP by 2025, in the presence of a US$30 per tCO_2 global tax. The results from the R200 per tCO_2 simulation are slightly more negative, but remain relatively small. Even though a carbon tax is seen to contribute to reductions in emissions, it will fail to achieve the Copenhagen targets on its own. This emphasises the need for complementary measures. The impact on emissions is also limited due to emissions by the electricity sector, which is driven largely by the IRP. Nevertheless, the analysis shows that measures to reduce carbon leakage and loss of competitiveness can reduce some of the output losses in carbon-intensive sectors.

6.2 World Bank model

162. The World Bank study (Devarajan et al., 2009) explores the economic welfare impact of a carbon tax relative to alternative energy taxes devised to reduce CO_2 emissions by 15 per cent. To attain this degree of reduction in emissions, the carbon tax is set at approximately US$22 (R165) per metric ton in the low elasticity case, and at about US$13 (R96) per metric ton in the higher elasticity case (2003 US dollar value). A CGE model is used to simulate a carbon tax, a sales tax on energy (inputs), and a sales tax on energy-intensive sectors, all of which are set to achieve the same level of reduction. Given a target reduction of CO_2 emissions, the economic cost of the various tax instruments depends on several factors, including:

- The relative substitutability of energy inputs with capital and other intermediate inputs
- The relative substitutability among energy inputs. Various tax and non-tax-related distortions in the economy.

163. Given the assumptions, two sets of elasticities have been devised: a reference case (which assumes higher elasticity) and the rigid case (which assumes lower elasticity). Table 5 shows the welfare impacts associated with each tax instrument, expressed as a percentage change from the base values for easy comparison.

Table 5: Welfare impacts of a 15 per cent reduction in CO_2 emissions by tax policy

Equivalent variation, percentage change from baseline household expenditure							
Household income deciles	Base value	Tax on carbon emissions by activities	Sales tax on energy	Sales tax on energy-intensive sectors	Tax on carbon emissions by activities	Sales tax on energy	Sales tax on energy-intensive sectors
		I. Reference case			II. Rigid case		
1st (poorest)	11.22	–1.38	0.23	0.80	–1.98	2.23	1.21
2nd	15.76	–0.77	1.82	3.37	–1.03	4.79	4.41
3rd	21.79	–0.62	1.23	–1.17	–0.66	3.95	–1.15
4th	28.41	–0.28	1.92	–0.33	–0.16	4.91	–0.14
5th	36.81	–0.41	0.92	–3.9	–0.31	3.29	–4.51
6th	47.1	–0.39	0.54	–4.77	–0.28	2.6	–5.59
7th	65.6	–0.37	–0.13	–5.29	–0.27	1.33	–6.28
8th	92.22	–0.44	–0.95	–5.15	–0.44	–0.29	–6.17
9th	135.95	–0.45	–1.84	–4.24	–0.43	–1.8	–5.07
10th – lower 5%	105.23	–0.35	–1.51	–3.36	–0.27	–1.26	–4.05
10th – next 1.25%	36.12	–0.14	–2.22	–4.39	0.23	–2.08	–5.21
10th – next 1.25%	42.62	–0.16	–1.76	–2.63	–0.06	–2.1	–3.25
10th – next 1.25%	48.22	–0.12	–1.31	–1.77	–0.11	–1.66	–2.32
10th – top 1.25%	99.27	0.02	–0.15	2.78	–0.45	–1.55	2.76
TOTAL	786.32	–0.33	–0.72	–2.76	–0.35	–0.19	–3.35

Notes: Energy = coal, electricity, gas and petroleum

Energy-intensive sectors = basic iron and steel, transportation, basic non-ferrous metals, and metal products excluding machinery.

Source: CGE model simulations (Devarajan et al., 2009: 15; Table 5).

164. The outcomes of the study (in the reference case) imply that carbon tax is the most economically efficient of the tax instruments, as its associated welfare cost is the lowest. Factor adjustments (the proportion of the employed labour force that must change sectors of employment) are the lowest for a tax on carbon. The impact of various instruments on the economic output is as follows: –0.2 per cent for a carbon tax, –0.41 per cent for a tax on energy, and –1.47 per cent for a tax on energy-intensive sectors. In the rigid case, the tax on energy

inputs has the least reduction in GDP, with the tax on energy-intensive sectors faring the worst.

165. A higher energy cost resulting from a carbon tax will generally dampen the production of energy-intensive activities, while non-energy-intensive activities will benefit from increased output. Output adjustments for the various activities range from 2.5 to –15 per cent in the reference case, and from 30 to –50 per cent in the rigid case.

166. The study concludes that a carbon tax is the best option in terms of the consistency of its aggregate efficiency or welfare results in both the low and higher elasticity cases. If the revenue raised can be used to reduce other distortive taxes, the welfare costs become negligible.

7. Carbon tax design features

167. The carbon tax discussion paper (NT, 2010) recognises the important role that carbon taxes play in internalising the external costs of climate change and creating the correct incentives to stimulate changes in the behaviour of producers and consumers. Development and technology innovation will result due to research stimulation towards cleaner and low-carbon technologies, as well as the promotion of the uptake of energy-efficient measures. Pricing and taxing carbon will also change relative prices throughout the economy and so provide for a more level playing field for the less carbon-intensive products and processes.

168. An appropriately designed carbon tax should internalise the external costs of GHG emissions; act as a strong enough signal to encourage change in behaviour; and facilitate least-cost reductions in emissions. Emissions reductions should ideally take place where the costs to abate pollution are the lowest, by providing flexibility to firms in the manner and extent to which investments are made to curb emissions. In short, a carbon tax will create incentives for producers to invest in low-carbon alternatives and energy efficiency measures. It will provide continuing incentives for research, development and technology innovation. This will contribute to the overall reductions in emissions and ensure that changes in relative prices allow consumers to make more informed choices.

169. Following wide consultation in 2011, the government has developed the present carbon tax policy with the following key considerations:

- The tax should be technically and administratively feasible to implement.
- Over time, the tax rate should be equivalent to the marginal external damage costs of GHG emissions. However, in the absence of an international climate change agreement and therefore of a global pricing for GHG emissions, a relatively modest net carbon tax is proposed during the transition period.
- Tax-free thresholds and offsets, combined to a maximum of 90 per cent, are proposed to allow for a relatively smooth transition, which will reduce the negative impact on the competitiveness of local firms and alleviate the burden on households.
- Revenue recycling through tax shifting, and on budget funding for specific social and environmental programmes, will be considered. These include existing support for energy efficiency, renewable energy, public transport and other green economy measures. These measures should also reduce the impact of the carbon tax on poor and low-income households. Relief measures should be of a temporary nature.

7.1 Tax base

170. The 2010 carbon tax discussion paper proposes three options for implementing a carbon price through a carbon tax. The following tax bases are defined:

- Tax levied directly on measured GHG gas emissions
- Fossil fuel input tax (tax on coal, crude oil and natural gas, based on carbon contents)
- Tax levied on energy outputs (e.g. electricity and transport fuels).

171. The best option is to impose the levy directly on the actual emissions of GHG or CO_2 equivalents.

This will create the appropriate incentives for investments in end-of-pipe technologies, such as carbon capture and storage. However, a tax on actual emissions would not be feasible at this stage.

172. The second best option, namely a fossil fuel input tax, is in many instances an equivalent tax base to that of a directly measured emissions tax. The tax imposed on fuel inputs with GHG emissions is derived from either approved emissions factors or a transparent, verified measuring and monitoring procedure. This alternative procedure may be necessary in the case of process emissions resulting from the chemical reactions of certain manufacturing processes, such as cement, glass, aluminium and chemicals production.

173. Following extensive consultation, a preference for a fuel input tax emerged. The DEA will prescribe and/or approve the appropriate emissions factors and procedures. It will also introduce mandatory reporting of GHG emissions for entities, companies and installations that emit in excess of 100 000 tons of GHGs annually, or consume electricity that results in more than 100 000 tons of emissions in the electricity sector.

7.2 GHG emissions by sector

174. The key GHGs emitted in South Africa are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and perfluorocarbons (PFCs), which account for approximately 79, 16, 5 and 1 per cent of total GHG emissions respectively, according to the Greenhouse Gas Inventory (DEAT, 2009). In absolute terms, total GHG emissions in 1994, 2000, and 2009 amounted to 380, 461, and 547 million tons, respectively. Emissions from the energy sector due to electricity generation, petroleum refining and transport accounted for more than 80 per cent of total emissions in 2000, followed by the agricultural and industrial sectors at 8.4 and 7 per cent, respectively. The sources of GHG emissions are diverse and include:

- Scope 1: Direct GHG emissions from sources that are owned or controlled by the entity (e.g. emissions from fuel combustion and industrial processes).
- Scope 2: Indirect GHG emissions resulting from the generation of electricity, heating and cooling, or steam generated off site but purchased by the entity.
- Scope 3: Indirect GHG emissions (not included in scope 2) from sources not owned or directly controlled by the entity but related to the entity's activities (i.e. emissions that occur in the value chain of the reporting company).

175. Consequently, economic sectors across the board will be impacted either directly or indirectly by the carbon tax as it filters through the economy. The carbon tax will cover Scope 1 emissions, which result directly from fuel combustion and gasification, as well as from non-energy industrial processes (e.g. carbon dioxide, methane, nitrous oxide, perfluorocarbons, hydrofluorocarbons and sulfur hexafluoride).

176. Complementary measures and incentives will be rolled out, such as the proposed energy efficiency savings tax incentives to be implemented prior to introducing the carbon tax. This will be done in order to encourage businesses to reduce their Scope 2 emissions that result from the use of purchased electricity, heat or steam.

177. Table 6 summarises the different processes that generate Scope 1 emissions, the energy inputs,

and the type of GHG emitted.

Table 6: Description of Scope 1 emissions from different processes and sectors

Process or sector	Energy inputs	Type of GHG	Description
Electricity generation	Coal, natural gas, petroleum products (e.g. diesel), renewable fuels	CO_2, CH_4	Fuel inputs are used to generate heat or steam in order to power boilers and turbines that generate electricity.
Coal and gas to liquid (gasification)	Coal, natural gas, crude oil, diesel	CO_2, CH_4	Gas preparation in the coal-to-liquid process. Coal is converted to synthesis gas consisting of hydrogen and carbon monoxide, as feedstock into the Fischer-Tropsch process. The hydrogen-to-carbon ratio is adjusted by injecting carbon in the form of carbon dioxide.
Crude oil refining	Crude oil	CO_2	Direct emissions result from fired steam boilers, fired process heaters and catalytic cracking unit regeneration.
Mining	Electricity, coal	CO_2, CH_4	Surface mining and underground mining activities result in methane emissions.
Cement	Coal, electricity, limestone or calcium carbonate	CO_2	Process emissions result from the calcination of calcium carbonate to calcium oxide, which produces CO_2 as a by-product and clinker production emissions.
Paper and pulp	Coal, gas, oil, biomass	CO_2	Direct process emissions derive from coal and gas-fired boilers used for electricity generation. Oil is used in the start-up phase. Biomass-based renewable fuel is combined with coal to generate electricity where the renewable fuel (e.g. black liquor) is deemed to be a waste product from the paper and pulp process.
Iron and steel	Coal, natural gas, electricity, liquid fuels	CO_2	Process emissions due to the production of iron and steel as follows: • Integrated or coal-based production route comprising coke making, sinter, blast furnace and basic oxygen furnace facilities • Coal-based direct reduction facilities where the main inputs are coal and electricity; here the primary role of coal is that of a reductant • Emissions from the recovery of waste metal. Direct use of electricity as an input in electric arc furnace operations where scrap metal is recycled.
Aluminium	Liquefied petroleum gas, low sulphur oil, diesel, petrol and electricity	CO_2, PFCs	Process emissions from melting primary and scrap aluminium, heating of ingots for hot rolling, and homogenising and annealing of metal in the process.
Chemicals		CO_2, N_2O, CH_4	Direct process emissions from: • Calcium carbide production

Process or sector	Energy inputs	Type of GHG	Description
			• Carbon black formation • Titanium dioxide production • Ammonia production • Nitric acid production.
Glass	Natural gas, electricity, liquid fuels	CO_2	Direct emissions from: • Processes at glass melting furnaces for melting raw materials, glass conditioning, container-forming machines, and glass annealing • Flat glass manufacture for glass melting • Decomposition of soda ash, dolomite and limestone. CO_2 emissions from natural gas used to produce electricity.
Transport	Diesel, petrol, compressed natural gas, aviation fuel, electricity	CO_2, CH_4	Combustion of fuels used in vehicles, aircraft and railways.
Agriculture, forestry and land use		CO_2, CH_4, N_2O	Direct emissions resulting from specific processes, as well as net emissions arising from agriculture, forestry and land-use related activities. These include enteric fermentation, manure management and land use (forest land and cropland).
Waste		CO_2, CH_4, N_2O	Emissions arising from solid waste disposal, biological treatment of solid waste, incineration and open burning of waste, wastewater treatment or discharge. The treatment of wastewater from domestic, commercial and industrial sources contributes to anthropogenic emissions of methane and nitrous oxide.

Sources: DEAT (2009); and responses to the list of questions circulated by the National Treasury in August 2011.

178. An important aspect in developing climate change policy, both domestically and internationally, is to determine the appropriate levels of actions required to support GHG mitigation. GHG emissions reporting is usually conducted on the absolute level of emissions from a particular entity or installation within a firm, which is essential for measuring and reporting on domestic emissions levels. In 2009, South Africa voluntarily announced its intention to curb its GHG emissions by 34 per cent by 2020 and 42 per cent by 2025, relative to a business-as-usual emissions trajectory. This would be subject to adequate levels of financial, technological and capacity-building support received from developed countries.

179. The environmental effectiveness of the instrument leading to reduced GHG emissions will depend in part on the availability of mitigation technologies and process adjustments that can help reduce direct emissions. These include fuel switching, improved energy efficiency, and cleaner production efforts. Table 7 shows the estimated contribution of the different sectors to absolute GHG emissions in South Africa.

Table 7: Absolute GHG emissions for South Africa (2000 GHG Inventory)

No.	Sectors/activities	Carbon dioxide (CO_2)	Methane (CH_4)	Nitrous oxide (N_2O)	Total GHG emissions, 2000 ($MtCO_2$-eq)	Percent-age contri-bution	Cumula-tive contri-bution
1.	**Fuel combustion**	**263,574.20**	**210.85**	**1,459.70**	**265,245**		
1.1	Electricity generation	178,534.94	38.95	862.53	179,436	39%	**39%**
1.2	Petroleum refining	39,777.89	10.89	176.29	39.965	9%	**48%**
1.3	Chemicals	17,393.36	3.98	82.78	17,480	4%	**51%**
1.4	Iron and steel	15,956.63	0.43	0.17	15,957	3%	**55%**
1.5	Residential	5,547.25	122.25	258.90	5,928	1%	**56%**
1.6	Agriculture; forestry; fishing	3,705.54	3.06	9.74	3,718	1%	**57%**
1.7	Commercial; institutional	1,901.60	0.43	9.28	1,911	0%	**57%**
1.8	Other mining and quarrying	317.91	0.11	1.41	319	0%	**57%**
1.9	Non-metallic metals	161.62	29.67	58.40	250	0%	**57%**
1.10	Food processing; beverage; tobacco	55.55	0.03	0.04	56	0%	**57%**
1.11	Non-ferrous metals energy	100.17	0.99	0.07	101	0%	**57%**
1.12	Pulp, paper and print	131.74	0.06	0.09	122	0%	**58%**
2.	**Fugitive emissions from fuels**	**26,297.37**	**44,879.71**	**–**	**71,177**		**58%**
2.1	Oil and natural gas	26,273.04	4,513.46	–	30,787	7%	**64%**
2.2	Coal mining	24.33	40,366.25	–	40,391	9%	**73%**
3.	**Transport**	**41,252.53**	**259,21**	**720.15**	**42,232**		**73%**
3.1	Civil aviation	2,014.91	0.30	17.49	2,033	0%	**73%**
3.2	Road transport	38,623.88	258.19	629.23	39,511	9%	**82%**
3.3	Railways	613.74	0.72	73.43	688	0%	**82%**
4.	**Agriculture, forestry and land use**	**(20,279.67)**	**22,136.94**	**18,636.00**	**20,493**		**82%**
4.1	**Aggregate sources and non-CO_2**	**471.00**	**1,072.26**	**18,220.60**	**19,764**		**82%**
4.1.1	GHG emissions from biomass burning	471.00	1,072.26	793.60	2,337	1%	**83%**
4.1.2	Indirect nitrous oxide emissions from managed soils	–	–	17,427.00	17,427	4%	**86%**
4.2	**Land**	**(20,750.67)**	**190.89**	**–**	**(20,560)**		**86%**
4.2.1	Forest land	**(13,020.52)**	–	–	(13,021)		**86%**
4.2.2	Cropland	(7,730.15)	–	–	(7,730)		**86%**
4.2.3	Wetlands	–	190.89	–	191		**86%**
4.3	**Livestock**	**–**	**20,873.79**	**415.40**	**21,289**		**86%**
4.3.1	Enteric fermentation	–	18,969.09	–	18,969	4%	**91%**
4.3.2	Manure management	–	1,904.70	415.40	2,320	1%	**91%**
5.	**Industrial processes and product use**	**30,557.53**	**304.38**	**1,217.42**	**32,079**		**91%**
5.1	**Mineral products**	**5,877.96**	**–**	**–**	**5,878**		**91%**
5.1.1	Cement production	3,604.96	–	–	3,605	1%	**92%**
5.1.2	Limestone and dolomite use	2,273.00	–	–	2,273	0%	**92%**
5.2	**Chemical industry**	**851.22**	**302.38**	**1,217.42**	**2,371**		**92%**
5.2.1	Ammonia production	435.64	–	–	436	0%	**92%**
5.2.2	Carbide production	64.58	–	–	65	0%	**92%**
5.2.3	Nitric acid production	–	–	1,079.42	1,079	0%	**93%**
5.2.4	Others	351.00	155.38	138.00	644	0%	**93%**
5.2.5	Soda ash production and use	–	147.00	–	147	0%	**93%**
5.3	**Metal production**	**23,828.35**	**2.00**	**–**	**23,830**		**93%**
5.3.1	Aluminium production	3,306.00	–	–	3,306	1%	**94%**
5.3.2	Ferroalloys production	5,009.00	2.00	–	5,011	1%	**95%**
5.3.3	Iron and steel	15,513.35	–	–	15,513	3%	**98%**

No.	Sectors/activities	Carbon dioxide (CO_2)	Methane (CH_4)	Nitrous oxide (N_2O)	Total GHG emissions, 2000 ($MtCO_2$-eq)	Percent-age contri-bution	Cumula-tive contri-bution
6.	**Waste**	**–**	**8,775.90**	**616.90**	**9,393**		**98%**
6.1	Solid waste disposal on land	–	8,085.00	–	8,085	2%	**100%**
6.2	Wastewater handling	–	690.90	616.90	1,308	0%	**100%**
Total CO_2-eq emissions without land use, land-use change and forestry		362,153	76,376	22,650	461,179		

Notes:

1. For CO_2 from land use, land-use change and forestry, the net emissions or removals are to be reported. For the purposes of reporting, the signs for removals are always negative (–) and for emissions positive (+).
2. Actual emissions should be included in the national totals, as per the 2006 IPCC Guidelines.
3. Countries are asked to report emissions from international aviation, marine bunkers and multilateral operations, as well as CO_2 emissions from biomass, under Memo Items. These emissions should not be included in the national total emissions from the energy sector. Amounts of biomass used as fuel are included in the national energy consumption, but the corresponding CO_2 emissions are not included in the national total, as it is assumed that the biomass is produced in a sustainable manner. If the biomass is harvested at an unsustainable rate, net CO_2 emissions are accounted for as a loss of biomass stocks in the land use, land-use change and forestry sector.

180. More than 80 per cent of GHG emissions in South Africa are produced by fuel combustion, fugitive emissions from fuels, and the transport sector. Box 1 assesses the merits of reduction targets for absolute versus intensity-based GHG emissions. Figure 2 shows the contributions of the key sectors to the country's GHG emissions.

Box 1: Absolute and intensity-based GHG emissions

There are two broad types of GHG targets:

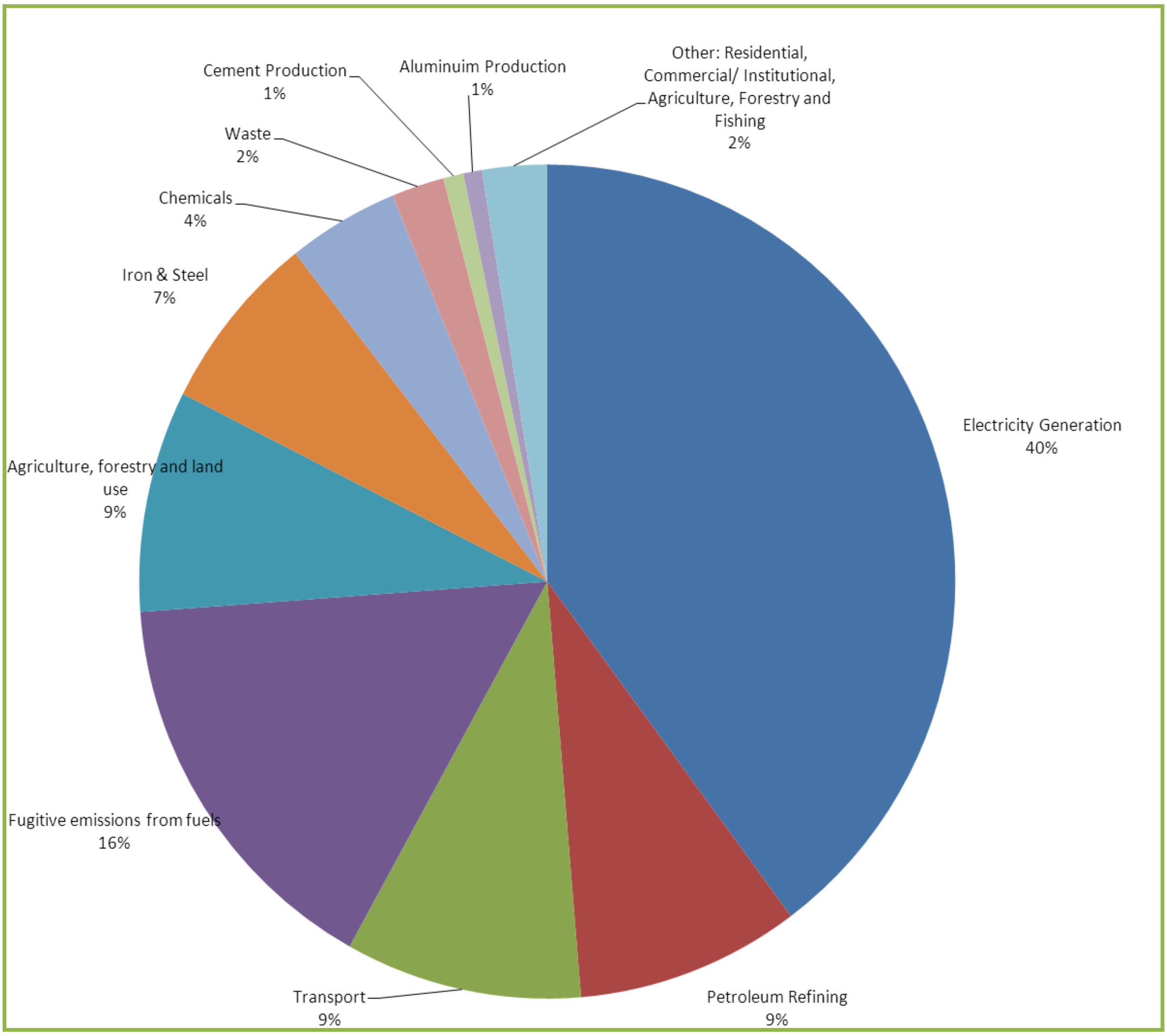
- Absolute reduction targets, which are usually expressed as a percentage reduction in total emissions, defined with reference to a baseline year and to be achieved by an agreed target date
- Intensity-based targets, which are usually stated as a reduction in the ratio of GHG emissions relative to another business metric, such as product output, turnover or floor space.

Absolute reduction targets are environmentally robust and express a clear commitment to reducing total emissions by a defined amount. They are, however, challenging in the context of significant structural changes in an organisation – for instance, targets may be difficult to attain if the company grows unexpectedly. Conversely, targets may be met simply by reducing output (e.g. in an economic downturn) or by divesting from carbon-intensive businesses.

Intensity-based targets reflect improvements in a company's GHG performance independently of its economic growth or decline, and allow comparisons with similar companies. However, the disadvantage is that even if ambitious intensity targets are met, absolute emissions can increase if outputs increase at a faster rate.

Source: Incite (2010).

Figure 2: Breakdown of South Africa's GHG emissions by sector



181. Absolute emissions levels will vary depending on the level of economic activity. In certain instances, the perceived progress in mitigating emissions may actually be attributed to a reduction in production levels, as opposed to investments or process adjustments made to curb emissions levels. The use of a carbon emissions intensity measure plays an important role at both the national and firm levels in assessing the carbon efficiency of a particular activity; for tracking the relative impact of a firm's operation; and, to a certain degree, for comparing (also referred to as benchmarking) firms in a particular sector.

182. Carbon emissions intensity is typically measured in terms of emissions per unit of product output, area of floor space, or number of employees. The choice of the most appropriate measurement technique will also depend on the nature of the economic activity. An intensity-based benchmark will be used in one aspect of the carbon tax design (see Box 2).

7.3 Sector thresholds

183. Given that South Africa is still an emerging economy facing significant socioeconomic challenges, the proposed carbon tax policy comprises the following key elements:

- A phased approach to the implementation of the carbon tax
- Cognisance of possible carbon leakage and competitiveness concerns
- Application of a *percentage-based threshold of actual emissions*, instead of absolute emissions thresholds, below which the tax will not be payable during the first phase
- Due consideration for sectors where the potential for emissions reduction is limited for either technical or structural reasons (initial consideration suggests that this will include the cement, iron and steel, aluminium and glass sectors)
- Additional relief for trade-exposed sectors
- Offsets that could be used by firms to reduce their carbon tax liability up to a limit.

184. The carbon tax will apply to all direct, stationary sources of emissions, including process emissions. To manage the transition to a low-carbon economy, a *transition period will provide for temporary thresholds below which an exemption from the carbon tax will be granted*. In addition, an offset mechanism similar to the Clean Development Mechanism (CDM) administered locally and in a more streamlined way, will be considered.

185. Table 8 summarises the proposed tax-free thresholds for the CO_2-eq emissions tax and the maximum percentage offsets allowed.

Table 8: Tax-free emissions thresholds by sector (%)

Sector	Basic tax-free threshold*	Maximum additional allowance for trade exposure	Additional allowance for process emissions	Total	Maximum offset
Electricity	60	–	–	60	10
Petroleum (coal/gas to liquid)	60	10	–	70	10
Petroleum – oil refinery	60	10	–	70	10
Iron and steel	60	10	10	80	5
Cement	60	10	10	80	5
Glass and ceramics	60	10	10	80	5
Chemicals	60	10	10	80	5
Pulp and paper	60	10	–	70	10
Sugar	60	10	–	70	10
Agriculture, forestry, land use	60	–	40	100	0
Waste	60	–	40	100	0
Fugitive emissions – coal mining	60	10	10	80	5
Other	60	10	–	70	10

Note: *Below this threshold no carbon tax will be payable during the first phase (2015–19).

186. The proposed basic tax-free threshold of 60 per cent, the additional tax-free threshold for

process emissions for trade-exposed sectors, and the maximum offset percentages of 5 and 10 per cent for the different sectors will remain fixed during the first phase of the introduction of the carbon tax (2015–19). The percentage tax-free thresholds will be reduced during the second phase (2020–25) and may be replaced with absolute emissions thresholds thereafter.

187. Both the tax-free percentage thresholds and their subsequent replacement with absolute emissions thresholds should be aligned with the proposed carbon budgets, as per the 2011 White Paper or any subsequent commitments. The carbon tax design and the tax-free thresholds by sector will have to take cognisance of any unintended consequences, as the incentive to reduce Scope 1 emissions should not result in increasing Scope 2 emissions.

188. Firms will be encouraged to reduce the carbon intensity (including both Scope 1 and Scope 2 emissions) of their products. This could be accommodated by adjustments, either increases or decreases, to the basic tax-free threshold of 60 per cent by a factor *Z*. Box 2 explains the formula to be used to determine these adjustments. Adjustments to the 60 per cent basic tax free threshold will be limited to 5 percentage points, up or down. The overall maximum tax-free threshold (including offsets) will be limited to 90 per cent during the first phase (2015–19). This maximum threshold will be decreased progressively in subsequent phases.

189. For practical reasons, primarily measurement difficulties, the agriculture, forestry, land use and waste sectors will be completely exempt during the first phase of implementing the carbon tax.

190. Box 2 explains the basic percentage tax-free threshold adjustment and gives illustrative examples.

Box 2: Possible adjustments to the basic percentage tax-free threshold of 60 per cent

Percentage thresholds will be used to quantify an entity or a firm's carbon tax liability, based on its absolute emissions for that year. A formula is proposed to adjust the basic 60 per cent tax-free threshold in order to take into account efforts firms have already made to reduce their emissions, as well as to encourage firms to invest in low-carbon alternatives. The basic 60 per cent threshold, below which the carbon tax will not be payable, may be adjusted using a carbon emissions intensity factor for output compared with an agreed sector benchmark.

A formula is proposed to calculate a factor *Z* which will be used to adjust (increase or decrease) the basic percentage tax-free threshold, as described below:

$$Z = Y / X$$

where:

- X is the average measured and verified carbon intensity (including both Scope 1 and Scope 2 emissions) of a firm's output
- Y is the agreed benchmark carbon emissions intensity (including both Scope 1 and Scope 2 emissions) for the sector.

The adjustment to the tax-free threshold is determined by multiplying the original percentage threshold by *Z*.

Example:

Assume that the agreed benchmark carbon emissions intensity is 0.91 tCO_2-eq per ton of output. Further assume that the absolute level of GHG emissions for three different firms, A, B and C, is 100 000 tCO_2-eq for each firm. The basic percentage tax-free threshold is 60 per cent. The carbon emissions intensity for Firm A is 0.91 tCO_2-eq per ton of output, for Firm B it is 0.85 tCO2-eq per ton of output, and for Firm C it is 1.1 tCO_2-eq per ton of output. The factor by which the basic percentage tax-free threshold (*Z*) should be adjusted for each of the three firms is:

$$Z = Y / X$$

Firm A: $Z = 0.91 \div 0.9.1 = 1.0000$
Firm B: $Z = 0.91 \div 0.85 = 1.0706$
Firm C: $Z = 0.91 \div 1.1 = 0.8273$

Hence the adjusted basic percentage tax-free thresholds for the three firms are as follows:

Firm A = $0.6 \times Z = 0.6 \times 1.0000 = 0.60000$ = 60.000 per cent
Firm B = $0.6 \times Z = 0.6 \times 1.0706 = 0.64236$ = 64.236 per cent
Firm C = $0.6 \times Z = 0.6 \times 0.8273 = 0.49638$ = 49.638 per cent

The basic percentage tax-free emissions are therefore:

Firm A = 60.000 per cent of 100 000 tons = 60 000 tons
Firm B = 64.236 per cent of 100 000 tons = 64 236 tons
Firm C = 49.638 per cent of 100 000 tons = 49 638 tons

Given that the carbon emissions intensity for Firm A is the same as the benchmark figure, its basic percentage tax-free threshold remains unchanged. Firm B is doing better than the carbon emissions intensity benchmark, hence qualifies for a higher basic percentage tax-free threshold. Firm C, on the other hand, is doing worse than the carbon emissions intensity benchmark and has been penalised for this poor performance. Firm C's basic percentage tax-free threshold is reduced from 60 to 49.64 per cent. Adjustments to the 60 per cent basic tax free threshold will be limited to 5 percentage points, up or down.

191. Table 9 briefly presents the emissions intensity ranges for the different processes from several sources. It also gives the IPCC emissions factors (IPCC, 2006: Vol. 2 & 3) and those of the World Business Council for Sustainable Development (WBCSD) (NCASI, 2005).

Table 9: Estimated emissions intensities for different sectors and processes

Activity / process	Emissions intensity	IPCC emissions factors	WBCSD emissions factors
Electricity generation			
Non-renewable-based power stations			
Return-to-service stations	1.05–1.28 tCO_2/MWh		
Existing power stations	0.8–1.3 tCO_2/MWh		
New power stations	0.80–0.90 tCO_2/MWh		
Existing fleet (average)	1.04 tCO_2/MWh		
Ultra-supercritical	0.716 tCO_2/MWh		
Natural gas (open cycle, combined cycle, and liquefied natural gas)	0.42–0.60 tCO_2/MWh		
Nuclear	0.04 tCO_2/MWh		
Renewable-based			
Hydro-biomass decay	0.249 tCO_2/MWh		
Biomass	0.036 tCO_2/MWh		
Wind	0.01 tCO_2/MWh		
Hydro	0.004 tCO_2/MWh		
Bark	0.094 tCO_2-eq/GJ	0.112 tCO_2/GJ	0.109 tCO_2/GJ
Black liquor	0.095 tCO_2-eq/GJ	0.095 tCO_2/GJ	0.0953 tCO_2/GJ
Liquid fuel production			
Coal-to-liquid gasification	3.4 tCO_2-eq/t		
Crude oil refining		0.073 tCO_2/MJ	0.0726tCO_2/MJ
Iron and steel	1.4–8.5 tCO_2/t (range)		
Basic oxygen furnace		1.46 tCO_2/t of steel	
Open hearth furnace		1.72 tCO_2/t of steel	
Electric arc furnace	1.4–1.6 tCO_2/t	0.08 tCO_2/t of steel	
Electric arc furnace and direct reduction	1.6–2.8 tCO_2/t		
Integrated blast furnace	2.8–3.5 tCO_2/t		
Vanadium, iron and steel	7.8–8.5 tCO_2/t		
Paper and pulp			440 kg CO_2/t $CaCO_3$ 415 kg CO_2/t Na_2CO_3
Cement	415–985 kg CO_2/t (depending on the type of cement)	0.43971 tCO_2/t carbonate	
Glass	0.2 tCO_2 /t glass (decomposition of carbonate raw materials)	0.21 tCO_2/t glass	
Lime carbonates		0.75 tCO_2/t	

Activity / process	Emissions intensity	IPCC emissions factors	WBCSD emissions factors
Chemicals			
Nitric acid		2–9 kg N_2O/t	
Cracker products			
Ammonia		1.666–2.772 tCO_2/t NH_3	
Adipic acid			
Hydrogen / synthesis gas (including methanol)		0.67 tCO_2/t CH_3OH	
Soda ash		0.138 tCO_2/t natural soda ash	
Carbon black		2.62 tCO_2/t	
Aromatics			

Note: Units are in kilograms (kg), metric tons (t), megawatt-hours (MWh), megajoules (MJ) and gigajoules (GJ), as indicated.

Source: Firms' responses to a list of questions circulated by the National Treasury in August 2011.

7.4 Offsets

192. It could be argued that, in the case of emissions from chemical processes that occur in fixed stoichiometric ratios (e.g. coal gasification, crude oil cracking, and the production of cement, iron, steel, glass, ceramic and certain chemicals, such as calcium carbide and titanium dioxide), there is limited potential for mitigation over the short term. Offsets are proposed to provide these and other sectors with additional flexibility to reduce their GHG emissions. The 2011 White Paper commits to developing carbon offset programmes actively and also recognises that offsets could help to incentivise biodiversity conservation.

193. Internationally, the largest offset mechanism is the CDM, under the Kyoto Protocol, where Annex 1 countries are allowed to invest in projects for reducing GHG emissions, including energy efficiency and renewable energy projects in developing countries (World Bank, 2012). South Africa currently has 41 registered CDM projects and additional 93 projects are at different stages of the project cycle, which will jointly lead to a considerable reduction in carbon emissions (DoE, 2013). Qualifying projects under the CDM need to demonstrate environmental and financial additionality; that is, a project that would result in reductions in net emissions would not be viable in the absence of carbon finance resulting from direct capital investments and purchases of certified emissions reductions (CERs) by developed countries.

194. In addition to the carbon offset market under the Kyoto Protocol, there is a growing demand for carbon offsets being traded in the voluntary carbon offset markets domain (Ecosystems Marketplace and Bloomberg New Energy Finance, 2012). A number of independent carbon offset accreditation mechanisms have therefore emerged. It is proposed that firms should be able to use verified offsets under the internationally recognised carbon offset standards (or, alternatively, more streamlined domestic offset programmes) to reduce their carbon tax liability up to a certain limit.

195. Work is currently underway on the specifics of the proposed carbon offset mechanism. Initial ideas regarding the proposed offset mechanism is included in Annexure E. A separate paper elaborating on design features for the offset mechanism will be published for comment later this year.

7.5 Proposed carbon tax rate

196. In principle, an environmentally effective and efficient carbon tax should aim for broad coverage, with minimum exemptions and exclusions for different GHGs and sectors applied at the rate equivalent to the marginal social damage costs. The aim of the proposed tax is to "correct" the prevailing prices of goods and services that generate excessive levels of anthropogenic GHG emissions. Ideally, the tax should apply at the rate at which the marginal cost to abate one additional unit of GHG emissions equals the marginal benefit of action. However, significant uncertainties arise due to the long-term nature of the climate change problem, the possibility of extreme events, and inaccuracies associated with global climate change modelling and the regional impacts of climate change (NT, 2010).

197. In order to allow for a relatively smooth transition to a low-carbon economy, and taking into account concerns about international competitiveness and the burden of higher energy prices on households, the government is proposing a relatively modest carbon tax of R120 per tCO_2-eq above the thresholds to be introduced in 2015, as discussed earlier. It is further proposed that the tax rate of a R120 per tCO2-eq be increased at a rate of 10 per cent per annum until the end of 2019, in order to provide a clear long-term price signal. This annual rate of increase will be reviewed during 2019, with the intention to announce a revised annual rate of increase in the 2020 Budget.

7.6 International competitiveness and border carbon adjustments

198. The impact of a carbon tax on the international competitiveness of local firms will depend on the nature of the goods or services traded, the market structure, and whether the producers are price takers or price setters in the international market. Potential adverse impacts on industry competitiveness could be addressed by introducing the tax at a relatively modest level initially, and increasing it gradually over time. A clear price path and timeframes for tax rate increases will provide the necessary price signals and certainty to influence producers' investment decisions over the medium to long term. R&D and technology innovation are essential for the transition to a low-carbon economy and will improve access to international markets.

199. It is argued that the implementation of a carbon price domestically, without equivalent policies for mitigating climate change in other countries, could affect the competitiveness of certain emissions-intensive industries. It could also result in carbon leakage (the displacement of emissions from one country to another due to the relocation of industry). Under the emissions trading scheme, such as the EU ETS and others, this issue has been partially addressed by the allocation of free allowances. The carbon tax design for South Africa, with its proposed initial relatively high tax-free thresholds, mimics such allocation of free allowances and should go some way to address the concerns about competitiveness and carbon leakage.

200. As an alternative (or in addition) to the EU's allocation of free allowances to mitigate the

potential negative impact on industry competitiveness, border carbon adjustments (BCAs) or border tax adjustments (BTAs) are under consideration. "BCAs are adjustments to the prices of traded goods based on some measure of the greenhouse gases embodied in the good. They can be applied to imports (as a tariff) or to exports (as a rebate). Although politically controversial, it is an important option for addressing leakage and declining competiveness caused by carbon pricing. They allow the substantial revenues currently tied up in free allowances to be recovered by governments" (Vivid Economics, 2012: 8).

201. Although the theoretical arguments for applying border adjustments are sound, there are significant practical and administrative challenges with this approach. The challenges relate to the complexities involved in determining the carbon content or emissions over the lifecycle of specific goods and services. Inaccuracies may arise from different production processes in different countries, which may in turn result in different levels of emissions. BCAs or BTAs could trigger the imposition of retaliatory tariffs. "If BCAs are to replace free allowances then it will be necessary to show that they are both as or more effective than free allowance allocation at addressing leakage and to show that they will not provoke retaliatory action and a trade war with countries outside the EU" (ibid.: 8).

202. BCAs are viewed to be potentially incompatible with World Trade Organisation (WTO) rules, depending on the design and implementation of the BCA (ibid: 114). They are best suited for homogeneous outputs because of the administrative complexity and costs of a BCA (e.g. steel, aluminium and cement). "One way of resolving certainty about the legality of BCAs is to deliberately choose to apply a BCA early in a sector where this may be controversial. This could mean that a WTO challenge occurs earlier and a more definitive view of legality is obtained quickly" (ibid: 119).

203. Trade-intensive industries can be defined as those industries in which exports and imports combined are more than 40 per cent of their domestic output; other references use 60 per cent as the threshold (see the discussion in Jooste et al., 2009). Table 10 gives an indication of the energy-intensive and trade-intensive (EITI) sectors.

Table 10: Categorisation of energy-intensive and trade-intensive sectors

Energy-intensive sectors	Trade-intensive sectors	EITI sectors
Iron and steel	Basic iron and steel	Iron and steel
Non-ferrous metals	Basic non-ferrous metals	Non-ferrous metals
Non-metallic minerals		
Chemical and petrochemical products		

Mining and quarrying	Gold and uranium ore mining	Gold and uranium mining
	Coal mining	Coal mining
	Other mining	Other mining
	Machinery and equipment	

Source: Winkler et al. (2010: 135).

204. At this stage, instead of taking the complex route of BCAs (or the so-called consumption-based carbon tax) in South Africa, tax-free thresholds are proposed, including a special maximum 10 per cent tax-free threshold for EITI sectors. This concession will be structured as a graduated relief. Firms will have the option to use either, exports only or exports plus imports as a percentage of output or sales as an indication of their trade intensity.

205. Where *both exports and imports* are used, the additional percentage relief (tax-free threshold) will be calculated as follows:

$$Y1 = 0.2 \times (E + I)$$

where $E + I$ = exports plus imports, expressed as a percentage of output or sales (it must be greater than 5 per cent), up to a maximum of 10 per cent, as indicated in Table 10.

206. Where *only exports* are used, the additional percentage relief (tax-free threshold) will be:

$$Y2 = 0.4 \times (E)$$

where E = exports expressed as a percentage of output or sales (it must be greater than 5 per cent), up to a maximum of 10 per cent, as indicated in Table 11.

Table 11: Trade-exposed tax-free threshold relief

Exports + Imports (E + I)		Exports only (E)	
0.2		0.4	
% of output	**% relief (Y1)**	**% relief (Y2)**	**% of output**
Below 10	0	0	Below 5
10	2	2	5
20	4	4	10
30	6	6	15
36	7.2	7.2	18
40	8	8	20
50	10	10	25
60	10	10	30
70	10	10	35
Y1 = 0.2 × (E+ I) E + I must be >10%		Y2 = 0.4 × E E must be >5%	
Maximum for Y1 or Y2 = 10%			

207. A possible alternative graduated relief for trade-intensive sectors could be:

$$Y1 = -2 + 0.24 \times (E + I) \text{ and } Y2 = -2 + 0.48 \times E$$

7.7 Application of the carbon tax design to specific sectors

7.7.1 Electricity generation

208. For the electricity sector, the proposed benchmark for the CO_2 emissions intensity of coal-fired power plants during the first phase is 0.91 t/MWh (which is the emissions intensity of the most efficient existing coal-fired power station). It will be reduced to 0.8 t/MWh during the second phase, which is the expected CO_2 emissions intensity for the new Kusile Power Station in Mpumalanga.

209. As expected, the highest level of absolute emissions reductions would need to take place at older, return-to-service stations, namely Camden, Grootvlei and Komati. These power stations are expected to be operational until 2023/24. Preliminary estimates indicate that these facilities would require emissions reductions of about 11 $MtCO_2$ to reduce their emissions intensities relative to the proposed benchmark. The dual benefits of emissions reductions and energy security of supply could be achieved through investments in the following:

- More energy efficient, grid-based electricity
- Appropriate retrofitting of these facilities
- Adequate consideration of off-grid electricity supply options.

210. In principle, electricity generation from renewable sources is deemed to be GHG emissions neutral and should not fall within the scope of the proposed carbon tax policy. However, firms will be expected to demonstrate the GHG neutrality of a particular facility by reporting on emissions using methodologies and emissions factors agreed to with the DEA.

7.7.2 Liquid fuels

211. South Africa's liquid fuel production is largely fossil fuel based, comprising coal, crude oil and natural gas as fuel inputs. The design of the carbon tax takes into account investments made by firms to shift away from carbon-intensive fossil fuels (e.g. coal) to cleaner alternatives (e.g. natural gas).

212. The tax-free thresholds, coupled with the flexibility to adjust the basic tax-free threshold of 60 per cent based on improvements in emissions intensities, provide significant incentives to firms. In particular, they allow firms that are relatively energy and carbon inefficient to undertake the required investments and process adjustments aimed at reducing their GHG emissions.

7.7.3 Non-stationary sources of emissions: transport

213. Transport fuel emissions result from the refining process (crude oil or coal gasification), as well as the use of fuel products (e.g. petrol, diesel and liquefied petroleum gas) to power motor vehicles. Vehicles include passenger vehicles, light-duty vehicles and heavy-duty vehicles, such as trucks and buses.

214. Transport sector emissions from road transport, civil aviation and railways are responsible for about 9 per cent of the country's total GHG emissions, with road transport accounting for a significant portion of this amount. Emissions are mainly the result of the combustion of fossil fuels (e.g. petrol and diesel) in motor vehicles and aviation fuel in aircraft. The level of emissions resulting from the combustion of these fuels can be quantified using emissions factors.

215. Currently, road transport fuels defined as fuel levy goods, namely petrol and diesel, are subject to the following fuel taxes: a general fuel levy, the Road Accident Fund levy, and customs and excise duty. Fuel taxes are increasingly being used to address environmental externalities. In South Africa, fuel levy goods are zero-rated for VAT purposes.

216. GHG emissions from the aviation and maritime sectors emanate from the use of fossil-based fuel for both domestic and international transport activities. Two of the issues associated with capturing emissions from these sectors within a domestic regime are the identification of the actual source of emissions of international flights, and the potential for carbon leakage due to possible fuelling and refuelling in countries that do not apply a carbon tax.

217. The GHG emissions in the international aviation and maritime sectors are currently being addressed under the UNFCCC, and the sectors are regulated by the International Civil Aviation Organisation (ICAO) and International Maritime Organisation (IMO), respectively. At present, aviation fuels used on both domestic and international flights are not subject to the suite of fuel taxes applied in South Africa.

218. The country is signatory to the Convention on International Civil Aviation, also known as the Chicago Convention, and abides by its provisions. Article 24 of the Convention stipulates that international aviation fuels shall be exempt from customs duty, inspection fees or similar national or local duties or charges. The aviation sector is subject to the following user charges and taxes locally:

- A fuel levy of 12.2 cents per litre applies to aviation fuel sales for non-scheduled operations.
- Airport charges are imposed on aircraft and passengers in order to fund the operation of the South African Civil Aviation Authority (SACAA) and the Airports Company South Africa (ACSA).
- International air passenger departure tax is applied to international air travel from South Africa, at R190 per fare-paying departing passenger to other countries, and at R100 per fare-paying departing passenger to countries within the Southern African Customs Union (SACU), including Botswana, Lesotho, Namibia and Swaziland.
- Domestic air passengers pay VAT, whereas international departing passengers do not.

219. South Africa supports a global approach to address GHG emissions from the international aviation sector, which includes the use of an appropriate carbon pricing measure, such as an internationally agreed carbon tax. Enforcing regional carbon pricing measures on the international aviation sector (e.g. by including the aviation sector in the EU ETS) could be disruptive and distortionary.

220. Emissions from domestic flights will be subject to the domestic carbon tax regime. It is proposed that the carbon tax be applied according to the carbon content of fuels used for domestic flights. The proposed domestic policy regime for aviation could be collapsed within an international approach for this sector at a later stage.

221. The South African government supports an international approach to dealing with the use of bunker fuels for shipping and the potential role of appropriate carbon pricing measures in creating the necessary price signals to stimulate behaviour change. Although the taxation of bunker fuels is not prohibited, there is significant potential for carbon leakage, as ships would have an incentive to refuel in countries where the carbon tax does not apply. At the same time,

determining the actual use of fuel on international or domestic ships is more difficult than for aircraft, as fuels can be purchased from a country without a carbon tax and used to refuel ships in the country applying the tax. The government will engage through appropriate international processes via the UNFCCC and IMO to develop appropriate policy instruments for addressing maritime GHG emissions.

222. International taxation of aviation and bunker fuels could generate significant revenues. These could also be used to offer financial support to non-Annex 1 developing countries that generate net emissions reductions associated with nationally appropriate mitigation actions, or assisting developed countries to fulfil their obligations to mitigate emissions (WB Group, IMF and OECD, 2011).

7.7.4 Agriculture, forestry and land use

223. Net GHG emissions arising from activities related to agriculture, forestry and land use include enteric fermentation, manure management, and use of forest and cropland. An accurate estimation of these sectors' emissions is problematic due to the long processes that cause GHG emissions and removals, which could be natural and/or anthropogenic.

224. Livestock emissions derive mainly from enteric fermentation and manure management. In 2000, enteric fermentation contributed approximately 19 million tCO_2-eq to total GHG emissions, largely through methane emissions. These livestock emissions depend on the animal population, livestock categories, and management practices. Similarly, nitrous oxide and methane emissions from manure management depend on the specific management practice applied, and the uncertainty range is therefore likely to be large. Indirect nitrous oxide emissions from agricultural lands are dependent on the quantity of the fertilisers and manure applied, and the inputs from nitrogen-fixing crops. The Department of Agriculture has initiated an inventory process intended to improve the emissions methodology and data collection from the sector.

225. It may be difficult to administer the application of the carbon tax to the agricultural sector, and inaccuracies and the absence of appropriate measurement and verification procedures for GHG emissions would be equally problematic. Therefore, it is proposed that agriculture-related emissions (except fuel-related emissions) be excluded from the proposed carbon tax during the first phase of 2015–2019. This concession will be reviewed during the second phase of implementation.

226. Forestry and land use serve as a net sink, and changes in the use of land and forests can either add carbon to, or remove carbon from, the atmosphere. Applying a carbon tax to these activities would require a complex baseline. An option exists for owners of these resources to participate through the use of offsets.

7.7.5 Waste

227. The main waste sector emissions involve solid waste disposal, biological treatment of solid waste, incineration and open burning of waste, and wastewater treatment or discharge. Some of the waste streams include waste from households, commercial businesses, institutions and industry. Methane emissions from urban managed-landfill sites contribute about 2 per cent of total GHG emissions in South Africa. Estimates for landfill methane emissions are surrounded by

uncertainties, including inadequate data on landfill depth, the actual levels of waste disposed of, and limited information on the composition of waste (e.g. the proportion of garden waste, wood and paper, and textiles).

228. Treatment of wastewater from domestic, commercial and industrial sources contributes to anthropogenic emissions of methane and nitrous oxide. Industrial wastewater can either be treated on site in septic systems, or disposed of untreated. Wastewater from domestic and commercial sources is treated through municipal wastewater treatment systems.

229. The significant uncertainties associated with waste sector emissions and poorly developed emissions methodologies complicate the inclusion of waste sector emissions under the proposed carbon tax policy regime. GHG emissions from the sector will be dealt with through alternative policies, as per the 2011 White Paper, and as part of the second phase of the carbon tax policy regime.

8. Revenue recycling and transitional support measures

230. The proposed carbon tax is intended to contribute to the government's policy on the mitigation of carbon emissions, and to facilitate the country's transition to a low-carbon economy. The carbon tax should not be seen as a measure to increase the overall tax burden, and as such, transitional measures to address potential adverse impacts on poor, low-income households and industry competitiveness are deemed necessary. Through targeted programmes and assistance, the government can help to catalyse and smooth the transition to a low-carbon, green economy for both households and businesses.

231. In facilitating the structural adjustment to a low-carbon economy, consideration will also be given to measures that aid companies to adapt their production processes and create employment opportunities in the low-carbon economy.

232. Potential recycling measures – through either the tax system or expenditure – will be explored. "The most common implementation of revenue recycling is to reduce employers' social security contributions or income taxes in compensation. Reductions in corporate taxes are unusual and there are no examples of reductions in indirect taxation such as value-added tax [...] Both ex ante and ex post studies analysing the impact of environmental tax reform with recycling tend to find positive impacts on employment and output" (Vivid Economics, 2012: 19–20).

8.1 Tax shifting

233. An appropriate balance should be struck between budget support measures, tax incentives and possible tax shifting. Some of these options were considered when the economic impact of a carbon tax was modelled. It might also be that a carbon tax could delay, or even prevent, increases in income tax or other taxes as part of an environmental fiscal reform agenda.

8.2 Rebates

234. To the extent that the carbon tax will cover gross emissions as opposed to net emissions, a rebate will apply in the case of carbon capture and storage (CCS). CCS presents technology that could be used to capture CO_2 emissions from the coal combustion and gasification processes in South Africa. The CO_2 is compressed, liquefied and then transported to a geologically stable site where it is permanently stored underground. A tax rebate for approved sequestration activities will be considered.

8.3 Flagship programmes

235. The government has identified priority flagship programmes to be implemented as per the 2011 White Paper. The proposed programmes described below are aimed at enhancing the country's climate change mitigation and adaptation efforts in the energy, water, transport and waste sectors:

- *Climate Change Response Public Works Flagship Programme:* This programme expands the existing Expanded Public Works Programme (EPWP) and consolidates initiatives (such as Working on Fire, Working for Water, and Working for Energy) in it.

- *Water Conservation and Demand Management Flagship Programme:* This programme includes the accelerated implementation of the National Water Conservation and Water Demand Management (WC/WDM) Strategy in the mining, industrial, electricity, agricultural and water service sectors.

- *Renewable Energy Flagship Programme:* This programme includes scaling up the renewable energy programme in line with the 2010 IRP, and enhances the deployment of renewable energy technologies. The DoE's solar water heating programme will be expanded to encourage local manufacturing capacity and the supply of solar heating products as part of the IPAP.

- *Energy Efficiency and Energy Demand Management Flagship Programme:* This builds on existing energy efficiency programmes, including Eskom's EEDSM programme and efforts by the National Cleaner Production Centre (NCPC) to support energy efficiency improvements in industry and expand the programme's coverage beyond electricity. It will include a residential energy efficiency programme for developing specifications for energy for low-income housing, as well as for regulating commercial and residential building standards to enforce green building construction practices. In addition, an energy efficiency programme for key government buildings will be developed.

- *Transport Flagship Programme:* The Department of Transport will facilitate the development of an enhanced public transport programme to promote lower-carbon mobility in five metros and ten smaller cities. An Efficient Vehicles Programme will also be created, with interventions that will result in improvements in the average efficiency of the South African vehicle fleet by 2020. Furthermore, the planned rail recapitalisation programme is an important component of this flagship programme and will facilitate passenger modal shifts and the shift of freight from road to rail.

- *Waste Management Flagship Programme:* The DEA will determine the GHG mitigation potential of the waste sector and investigate the opportunities for waste-to-energy conversion practices, as well as the production and capture of methane or landfill gas from waste sites. This information will be used to develop and implement a detailed waste-related GHG emission mitigation action plan, and detail appropriate policies for facilitating its implementation.

- *Carbon Capture and Sequestration Flagship Programme:* The DoE will lead this programme and a key outcome will be the development of a Carbon Capture and Sequestration Demonstration Plant to be used for storing process emissions from existing high-carbon emissions facilities.

- *Adaptation Research Flagship Programme:* This is both a national and regional research programme, led by the South African National Biodiversity Institute (SANBI). It will be designed and rolled out to scope sectoral adaptation requirements and costs. It will also identify adaptation strategies with cross-sector linkages and benefits. Included in the programme is an assessment of climate change vulnerabilities in the subregion, with a detailed scenario planning process to define potential sub-regional response strategies.

236. Coupled with effective carbon pricing, the government will also consider regulations for overcoming market failures associated with achieving the benefits of energy efficiency through technical norms and standards. Support will be provided for improving the cost efficiency of emerging technologies; for developing economies to capture the abatement potential from agriculture and forestry; and for linking these to appropriate carbon market mechanisms (DEA, 2011a).

8.4 Other support measures

8.4.1 Free basic electricity (energy)

237. Support to poor and low-income households to ensure access to affordable, safe, reliable and clean energy should be strengthened. The government has made significant progress in implementing the Integrated National Electrification Programme (INEP), which seeks to ensure electricity supply to all households, schools and clinics. The free basic electricity initiative of 50 kWh per month for indigent households, as part of the Free Basic Energy policy announced in 2003, has been rolled out with varying degrees of success. This initiative should be reviewed and strengthened where possible and options could be considered, such as an increase in the free basic allocation. However, there should first be a proper assessment of how effective the implementation of the current programme is. The review of block electricity tariffs by Nersa could be used as an opportunity to reduce the impact of escalating electricity prices on low-income households.

238. The National Liquefied Petroleum Gas Strategy aims to provide access to safe, cleaner alternative fuels for household use and encourages fuel switching by low-income households.

8.4.2 Energy efficiency and demand-side management

239. The government has implemented the EEDSM programme, which addresses concerns about energy supply security through rolling out specific energy efficiency and renewable energy technologies. The programme has been implemented primarily by Eskom and municipalities. EEDSM is financed through adjustments to the electricity tariff, which are supplemented by government grants channelled through the INEP. The programme and grants include:

- Support to businesses to reduce their electricity demand (Eskom's EEDSM programme)
- Subsidies for the installation of solar water heaters
- Subsidies to licensed distributors (municipalities) to address electricity demand-side management.

240. Funding for the above initiatives is included in either the current electricity tariffs or the electricity levy. An energy efficiency savings tax incentive will provide for a deduction made against a business's taxable income of the deemed monetary value of proven energy efficiency savings. The costs (tax expenditure) associated with this tax incentive should be viewed as part of the recycling of revenues anticipated from the carbon tax. (See Annexure C.)

8.4.3 Renewable energy

241. The rollout of renewable energy is being promoted through the following:

- The Renewable Energy Independent Power Producer (REIPP) procurement programme involves a bidding process by independent power producers to provide renewable energy to the national grid. The power producers would be expected to enter into an agreement with the DoE, and a PPA with a buyer, namely Eskom.
- The Renewable Energy Finance and Subsidy Office (REFSO) of the DME offer financial support for implementing and adopting new and renewable energy technologies.

242. The National Treasury is developing a funding mechanism to support the REIPP programme, which can be used as a vehicle to facilitate international climate funding. It is envisaged that the funding will largely consist of concessional loans and will target small-scale renewable energy projects with 1–5 MW installed capacity.

243. Renewable energy and cogenerated electricity are important to help diversify South Africa's energy mix; to ensure security of energy supply; and to contribute to reductions in GHG emissions. Access to the national electricity grid by the IPP will help to incentivise decentralised electricity generation from renewables and cogeneration by firms. The electricity will be for their own use or for supplying excess electricity and heat to nearby households, small businesses and hospitals. The government is also exploring special tariffs to support cogeneration similar to the renewable energy competitive bidding scheme.

8.4.4 Public transport and the shift of freight from road to rail

244. Reductions in GHG emissions from the transport sector can be achieved by improving the availability of more energy-efficient modes of freight and public passenger transport, and changing to cleaner fuels. The National Transport Master Plan (NATMAP) and the 2020 Public Transport Action Plan envisage the development of an effective and integrated infrastructure network, including safe and affordable public transport systems. The main pillars of the public transport strategy are as follows:

- The provision of accelerated modal upgrading and integrated rapid public transport networks to ensure broad coverage of the public transport systems
- The provision of alternative modes of transport
- The support of integrated networks in rural areas comprising non-motorised and periodic scheduled services.

245. The availability of safe and affordable (subsidised) public transportation is an important intervention to assist low-income households, and will also encourage middle-income households to switch from private to public transport. A significant proportion of South Africa's freight is also currently being transported by road due to an inadequate and often unreliable freight rail network. Initiatives to improve the rail network for freight and promote the shift from road to rail should be accelerated.

8.5 Other tax incentives

246. The government has, or is in the process of, implementing several environmentally related taxes and tax incentives. Table 12 summarises these tax incentives.

Table 12: Climate change-related tax incentives

Instrument	Description
Renewable energy depreciation allowance (Section 12B)	An accelerated depreciation allowance exists for capital equipment used for renewable electricity generation from wind, solar, small-scale hydro and biomass at the rate of 50: 30: 20 per cent over three years.
Depreciation allowance for biofuels production (Section B)	An accelerated depreciation allowance exists for capital equipment used for biofuels production at the rate of 50: 30: 20 per cent over three years.
Tax exemption for certified emissions reductions (Section 12K)	Revenues generated from the sale of certified emissions reductions resulting from projects under the CDM are exempt from income tax.
Biodiversity conservation and management expenses (Section 37C)	Income tax write-offs are provided for expenditure incurred in the management and maintenance of biodiversity and priority areas under the National Environmental Management Biodiversity Act and the Protected Areas Act.
Research and development tax incentive (Section 11D)	There is a 150 per cent income tax deduction for scientific and technological research and development expenditure, and research and development capital expenses can be written off at the rate of 50 : 30 : 20 per cent over three years.
Industrial policy incentive (Section 12I)	Energy efficiency-related criteria are given in the Industrial Production Policy incentive scheme.
Proposed tax incentive for energy efficiency savings (Section 12L)	Businesses can claim a deduction against taxable income in the form of an amount equal to the monetary value of proven energy efficiency savings.

8.6 Energy pricing, fuel taxes and the electricity levy

247. Given the current regulatory environment and market structure, the scope for the electricity sector to pass on the carbon tax to final consumers is quite high. It should, however, be noted that the electricity generation sector will not be immune to the impact of the carbon tax. The tax will impact on future investment decisions, and will also reduce the price-cost differential between fossil fuel-based, nuclear and renewable energy.

248. The current regulatory framework for determining the prices of liquid fuels (petrol, diesel, paraffin and gas) at wholesale and retail levels does not allow for a pass-through – either in full or in part – of the carbon tax imposed at refinery level. The likely impact on profitability of the inability of refineries to pass at least some of the carbon tax on to consumers should be further explored. An alternative might be to include an element of the carbon emissions at refinery level into a CO_2 component of refined fuel taxes.

249. A carbon price is deemed appropriate, even in the context of a not-so-perfect price-setting mechanism in the energy sector: "[A]lthough there are market failures which limit the

responsiveness of energy users to changes in prices, without those price signals, it will be difficult, if not impossible, to change behaviour. Carbon prices, in the form of taxes and trading, are an essential part of the policy prescription, and they need to be sufficiently high and sufficiently stable to promote reaction from the market" (Vivid Economics, 2012: 27).

250. The proposed carbon tax on fuel inputs has raised the issue of the continued relevance and appropriateness of existing fuel taxes and electricity levies. It could be argued that a carbon tax, in addition to these taxes, would amount to double taxation. Excise duties on liquid fuels (petrol and diesel) and electricity generated from non-renewable sources serve environmental demand-side management and revenue objectives. Some elements of the electricity levy is a mechanism for making some of the hidden cross-subsidies built into the current electricity tariffs more explicit and not necessarily directly linked to environmental objectives. Given the relatively low initial carbon tax rate, the relatively high exemption threshold and the possibility for offset credits, it is unlikely that there would be true double taxation for a long time to come.

251. Double taxation may only become an issue if the carbon tax rate is set at a sufficiently high level to fully internalise the external costs associated with carbon emissions. South Africa is probably many years away from reaching an effective (combined) carbon tax at such a high rate. However, to ensure the effective pricing of carbon and facilitate the structural change currently taking place in the energy sector, a gradual phasing-down and restructuring of the current electricity levy (energy tax) could be considered. Such restructuring should ensure that all large energy intensive users improve their energy efficiency and reduce their emissions, and do not escape the impact and intent of an energy and carbon tax through long-term pricing agreements.

Annexure A: Results from modelling the impacts of a carbon tax

252. Carbon emissions impose social and environmental costs on a country's economy. The Stern Report, for example, suggests that climate change will reduce welfare by an amount equivalent to the reduction in consumption per head between 5 and 20 per cent (Stern, 2006). Economic theory explains that the best way to deal with such costs is to internalise them in the consumption and production decisions of households and firms through a pricing mechanism.

253. A carbon price or carbon tax shifts production and consumption decisions away from environmentally unfriendly goods and services towards cleaner activities. As cleaner technologies become relatively cheaper, firms and households become more likely to implement them. This encourages greater investment in the development of greener technologies, such as carbon capture and solar energy.

254. The transition to a low-carbon economy depends on the current structure of the economy, the scope for technological and behavioural change, the way the tax is implemented, the way the revenues are used ("recycled"), and the extent to which trade, industrial and energy policies are coordinated with environmental policy. (Recycling refers to the way in which the government spends the additional revenue from the carbon tax. This can be done through increasing different types of expenditure, reducing other taxes, or providing incentives.) Revenues can be used to assist in adjusting taxes to create further incentives for firms and households to reduce their carbon emissions, and to encourage growth in greener technologies and industries.

255. The results of the modelling of an energy and/or carbon tax by the World Bank, the Energy Research Centre at the University of Cape Town, the University of Pretoria and the National Treasury are summarised in Table 13.

Table 13: Modelling results for an energy and/or carbon tax

	ERC, CT, LTMS, DEA	University of Pretoria	World Bank	UNU WIDER and National Treasury
Factors	Mitigation scenarios: 1 – Start now 2 – Scale up 3 – Use market	Model simulations: • Environment via CO_2 emissions • Economy via the GDP and employment • Equity via consumption by the poor	Modelling factors: • Relative substitu-tability of energy inputs with capital and other inter-mediary inputs • Relative substitutability among energy inputs • Economy-wide distortions: tax and non-tax-related (labour market rigidity)	• Tax implement-ation: immediately or gradually over 10 years • Baseline centred on the IRP2 revised scenario • Availability and affordability of greener technologies • Trade restrictions (exports) • Tax on consumption
Tax	Tax on coal, crude oil and gas: equivalent tax on various	Tax of R35 per tCO_2 emissions: • Carbon tax	Tax of R96 to R165 per tCO_2: • Pure carbon tax	Tax of R100, R150 and R200 per tCO_2: • As from 2012

	ERC, CT, LTMS, DEA	University of Pretoria	World Bank	UNU WIDER and National Treasury
	energy inputs: • Tax simulations of R25 to R1 000 per tCO_2 • R100 per tCO_2 in 2008 • R250 per tCO_2 in 2020 • R750 per tCO_2 from 2040–50	• Fuel tax • Electricity tax • Energy tax (All taxes have a comparable effect on emissions.)	(based on carbon content) • Excise tax on energy inputs (coal, gas and crude oil) • Sales tax on energy-intensive sectors (iron, steel and metals)	• Taxes are introduced gradually over a 10-year period.
Abatement	Emissions reductions: • 17 500 $MtCO_2$-eq from 2003–50 • 2050 emissions of 620 $MtCO_2$-eq	Different levels of abatement: • Carbon tax reduces emissions by 1.115 $GgCO_2$ per R million increase in tax revenue. • Recycling increases emissions per R million of tax recycled (depending on the type of recycling). • A combination of tax and recycling reduces emissions per R million tax recycled (depending on the tax and recycling measure).	All taxes have a comparable effect on emissions. The targeted abatement is a 15 per cent reduction in CO_2 emissions.	• The largest reduction in emissions is achieved when a tax of R200 per tCO_2 is introduced in 2012. • Emissions decline by 34 per cent by 2020 and over 42 per cent by 2025, relative to the baseline.
Results	• A tax of R75 per tCO_2 and increased to around R200 per ton seems appropriate. • Food subsidy yields the most positive result, with marginal increases in GDP at low levels of taxation. • Revenue recycling schemes (biofuel, food VAT) have a positive effect on employment. • Tax >R600 per ton: Coal to liquid	• All taxes yield an emissions dividend, with carbon tax being the most effective in reducing CO_2 emissions (first dividend). • A GDP dividend is achieved when combined with reduced food taxes (second dividend). • The food tax handback reduces poverty more than other recycling measures.	• A direct carbon tax imposes the lowest distortion compared with taxes on energy or energy-intensive sectors. • The distortion for direct taxes is 0.3 per cent of household welfare. • An energy-intensive sector tax is 10 times worse than a carbon tax. • The welfare cost is lower when labour flexibility increases.	• If carbon tax revenues are recycled via a reduction in the VAT rate, it leads to a smaller negative impact on GDP (–0.2) by 2035. • Reductions in CIT or PIT see the GDP decrease by 0.4 per cent by 2035. • Recycling revenue by increasing government savings and investment results in positive gains. • The tax causes a

	ERC, CT, LTMS, DEA	University of Pretoria	World Bank	UNU WIDER and National Treasury
	plants not viable.		• The impact on the GDP or consumption is generally less than 1 per cent, except for the sales tax on energy-intensive sectors (–1.47).	marginal reduction in inequality, as it reduces the profits of carbon-intensive sectors (top deciles).
Revenue recycling	• Production subsidies for nuclear or renewable energy and biofuels • Food subsidies • General VAT subsidies • Income tax subsidies • Household transfers	• Direct tax break, labour and capital • Indirect tax breaks to all households (VAT) • Reduction in the price of food	• Reductions in distortionary indirect taxes: production taxes, sales taxes, value-added taxes, and import tariffs • Lump sum transfers to households	• Recycling: VAT, PIT, CIT, transfers to households and/or government investments

Annexure B: Carbon price developments in other countries

256. Combinations of emissions trading schemes (ETSs), carbon taxes and other complementary regulatory policies have been used to reduce GHG emissions in different countries. More details on several carbon pricing policies follow below.

Canada – Alberta

257. In the province of Alberta, the largest potential source of emissions growth is the oil sands industry, which is also the fastest growing source of emissions in the country. According to the Rio Tinto Group, oil sands emissions could triple from 30 Mt to 92 Mt between 2005 and 2020.

258. The Alberta government's baseline and ETS have the following objectives and perspectives:

- Alberta's energy sector is evolving to meet a global market (especially that of the United States) which integrates energy security, environmental sustainability and economic growth.
- The programme should provide policy certainty for industry in terms of emissions intensity without mandating how specific emissions rates must be achieved. Very large investments being made currently will be expensive to retrofit; these investments often have a lifespan of 40-plus years.
- The implementation of new technology will be a large part of the long-term solution, notably carbon capture and storage.
- Market instruments, such as offsets and the Technology Fund, are needed to bridge the gap between current emissions and long-term solutions.
- The issue is energy system shifts – success will require strategic and focused investment in transformational changes in technology, behaviour, etc.
- Money raised in Alberta should be spent to develop solutions that reduce emissions in the province. Alberta is not supportive of a market-based system that would see funds transferred outside the province through allowance or offset purchases.
- Alberta intends to strengthen its price signal over time. In the current environment (where less is being done by other jurisdictions, rather than more), it would be hard to justify strengthening the price signal. Nonetheless, the province is very sensitive to the possibility of trade threats from other jurisdictions.

259. The ETS involves various compliance mechanisms, including onsite offsets, purchasing emissions performance credits (EPCs) and Alberta-based offsets, and contributing to the Technology Fund. The EPCs cover emitting facilities for emissions reductions in excess of the 12 per cent intensity reduction required of the facility. EPCs may be banked for use in future years. The Technology Fund is overseen at arm's length by the government.

260. Offsets and EPCs may be bought and sold via bilateral contracts. No exchange currently exists on which these instruments may be traded. Offsets are approved only for projects that reduce emissions within the province of Alberta. There is no pre-certification of offset projects that would give purchasers an assurance that if the project performs as designed, then the offsets will be considered compliance grade. This step has been intentional, as system designers sought to steer compliance efforts away from offsets and towards the Technology Fund.

261. The contribution rate to the Technology Fund is CAD15 per tCO_2-eq, which serves as a cap on

the cost of compliance for regulated facilities. However, contributions to the Fund will result in emissions reductions when the projects that are supported by the Fund become operational, not necessarily in the year that individual facilities contribute to the Fund for compliance purposes.

China

262. China's pledge to reduce its GHG emissions intensity by 40–45 per cent of carbon per unit of GDP by 2020 is supported by its target to reduce its carbon dioxide intensity (tCO_2/GDP) by 17 per cent from 2011–15. The government is considering implementing carbon pricing through a carbon tax and trading scheme by 2013 to help achieve this target (KPMG, 2011). The country's draft plan for National Economic and Social Development (PRC, 2011) contains these specific targets for new energy use and pollution and a cap on domestic coal production:

- Use of non-fossil fuel to be 11 per cent of the total energy use by 2015 and 15 per cent by 2020
- 16 per cent reduction in energy use per unit of GDP by 2015
- 17 per cent reduction in CO_2 emissions per unit of GDP by 2015.

263. The plan proposes pilot cap-and-trade programmes among its various targets. A pilot ETS has been envisaged for seven provinces and cities to work towards an absolute target, which requires predicting the GDP and energy consumptions for 2015 in order to calculate emission targets. This absolute target will cover 30–37 per cent of the country's total GHG emissions. There is the expectation that China will also issue regulations for domestic offsets soon – the Chinese Certified Emissions Reductions (CCERs) and any domestic offset projects will not be counted as CDM projects. The CCERs scheme is expected to be a voluntary system linked to the pilot ETS (PMR, 2012).

India

264. The government of India published details of its climate change response, entitled "India: Taking on climate change" in June 2010. The government has set up an expert group to develop a road map for ensuring low-carbon development to support inclusive growth in key sectors, including electricity, transport, industry, oil and gas, buildings and forestry.

265. To complement the coal tax, the government has approved an energy intensity-based trading scheme – the Perform, Achieve and Trade (PAT) Mechanism for Energy Efficiency – with its first cycle commencing in 2014–15. The benchmarks will be lowered in subsequent phases, while the number of covered units will increase. The PAT scheme strives to enhance cost-effectiveness through tradable energy saving certificates (ESCerts). ESCerts can also be partially issued ex-ante, with 1 ESCert = 1 metric ton of oil equivalent (toe).

266. Specific energy consumption (SEC) targets are given, which are plant specific for each installation. The targets are based on the consumer's current energy consumption, using average data for 2008, 2009 and 2010. The PAT covers 478 designated energy consumers, representing 40 per cent of total industrial consumption in eight sectors (thermal power, steel, cement, fertiliser, pulp and paper, textile, aluminium and chlor-alkali). Together they consume a total of 165 Mt of energy (PMR, 2012). Although the PAT initiative is focused on energy

efficiency, it is expected to achieve carbon emissions cuts at the end of the first cycle (2014–15) of about 25 million tons per year.

267. Some of the main initiatives under the National Action Plan on Climate Change include generating 20 000 MW of solar power by 2022 and 2 000 MW from off-grid solar plants; targeting 20 million ha of land for afforestation and eco-restoration; promoting energy efficiency in residential and commercial sectors; refurbishing urban transportation; and managing solid waste, water and wastewater.

Australia

268. The Australian carbon pricing regime has been informed by research that culminated in a White Paper in 2008. Some interesting observations from this document are as follows:

- "The consequent economic cost [of GHG emissions] is not currently reflected in the costs of business or the price of goods and services – because firms face no cost from increasing emissions, the level of emissions is too great. Unless businesses and individuals bear the full responsibility for their consumption and production decisions, the level of carbon pollution will remain too high" (Australia, 2008: xxv).
- "Placing a limit, and hence a price on emissions has the potential to change the things we produce, the way we produce them, and the things we buy" (ibid: xxvi).
- "The introduction of a carbon price will change the relative prices of goods and services, making emissions-intensive goods more expensive relative to those that are less emissions-intensive goods. This provides a powerful incentive for consumers and businesses to adjust their behaviour, resulting in a reduction of emissions" (ibid: xxviii).

269. The Australian government subsequently announced the implementation of its climate change plan during 2011, which recognises carbon pricing as a central element in its strategy of moving to a clean energy future. Under the proposed carbon pricing regime, which came into effect on 1 July 2012, there is a fixed carbon price similar to a tax in the first three years before moving to an ETS. One of the key elements of the fixed price regime of the Australian carbon pricing mechanism is that assistance is provided to sectors to manage the shift to a low-carbon future while taking account of trade exposure and the emission intensities of an activity. Two initial rates of assistance provided are as follows:

- 94.5 per cent of the industry-average baseline for activities with emission intensities of at least 2 000 tCO_2-eq per AUD million revenue, or at least 6 000 tCO_2-eq per AUD million value added
- 66 per cent of the industry-average baseline for activities with emission intensities between 1 000 and 1 999 tCO_2-eq per AUD million revenue, or between 3 000 and 5 999 tCO_2-eq per AUD million value-added.

Ireland

270. The introduction of a carbon pricing regime in Ireland has been considered part of the tax regime redesign to strengthen the Irish economy in the follow-up to the bailout during the global financial crisis. The Irish government introduced a carbon tax in 2010 to complement the EU ETS. While the EU ETS is designed to set a declining cap on GHG emissions from the energy-

intensive sectors (incorporating the power and heavy industry sectors), the carbon tax aims at capturing emissions not covered by the EU ETS (Ireland, 2009). The carbon tax thus includes mainly transport, waste and heat in buildings.

271. The carbon tax is based on a standardised measure of CO_2 content of the energy product and applies to energy products released for consumption in Ireland. Fuels covered under the tax can be divided into transport fuels, non-transport fuels and solid fuels. (Transport fuels under the tax include petrol and auto diesel; non-transport fuels include kerosene, marked gas oil, fuel oil, liquefied petroleum gas and natural gas; and solid fuels include coal and commercial peat.) The tax is levied upstream at the earliest practical point of supply, but is designed to be clearly visible at the point of final consumption (Ireland, 2009).

272. In order to provide equal incentives to reduce GHG emissions across the economy, the rate of the carbon tax was devised to correspond broadly to the price of the allowances available to installations covered by the EU ETS. The rate of the carbon tax is established annually for the upcoming period and is announced in the national budget.

273. The initial carbon tax rate, applied in 2010 and 2011, was set at €15 per tCO_2 and was subsequently increased to €20 in 2012. It is proposed that the rate be increased to €25 in 2013. While the aimed price symmetry between the EU ETS and the carbon tax rate was maintained in 2010 and 2011, there has been a considerable divergence in price since 2012, due to the sharp drop in carbon credits available through the EU ETS.

274. The carbon tax is estimated to have had a considerable impact on Ireland's GHG emissions – since 2008, emissions have decreased by more than 15 per cent. While a substantial proportion of the decline can be contributed to the drop in economic output during the financial crisis, GHG emissions in Ireland dropped by 6.7 per cent in 2011 alone, as the economy grew slightly (Convery, 2012). The data for petrol and auto diesel consumption supports this fact. Consumption of petrol fell from 2 377 million litres in 2007 to 1 829 million litres in 2011, which is a decline of 25 per cent, whereas the consumption of auto diesel dropped from 3 025 million litres in 2007 to 2 563 million litres in 2011, representing a decline of 15 per cent (Gargan, 2012). While the drop in fuel consumption can also be attributed to the rise in oil prices, the increase in the carbon tax rate by €5 in 2011 saw a pump price increase of 1.4 and 1.6 cents on petrol and auto diesel, respectively (CAI, 2012).

275. The impact of the carbon tax on retail prices thus far has been in the range of a 3.5 per cent increase in petrol prices and 4.4 per cent in auto diesel prices, to 8.4 per cent in kerosene prices and 11.1 per cent in coal prices (Gargan, 2012; Convery, 2012). Moreover, the estimated revenue of carbon tax was €210 million in 2010, €300 million in 2011, €400 million in 2012 and is expected to rise to €500 million in 2013 (Gargan, 2012). Considering the positive impact on revenue, as well as incentives for environmental efficiency, distributional concerns over the impact of the new form of resource taxation did not deter the introduction of a carbon tax. Studies examining the distributional implications of a carbon tax in Ireland conclude that "[t]he impact of a carbon tax of €20/tCO_2 is small compared to pre-existing taxes and benefits. A modest increase in welfare payments would offset the negative impacts of a carbon tax in the lower half of the income distribution" (Callan et al., 2008: 8).

Annexure C: Energy efficiency savings tax incentive

[Section 12L of the Income Tax Act]

Background

276. The primary energy sources in South Africa are fossil fuel based. Energy derived from fossil fuel has a negative effect on the environment, and current electricity prices do not reflect these environmental costs. Given the need to deal with the challenges relating to climate change and to improve energy use, it has become necessary to find ways to improve energy efficiency. Energy efficiency savings can be seen as one of the "low-hanging fruits" to help address the concerns relating to climate change and energy security.

Reasons

277. In the context of energy efficiency savings, the conversion of old technologies to new ones often involves a substantial amount of capital expenditure for the taxpayer. The perceived long payback period tends to discourage businesses from marking upfront investments relating to the energy efficiency saving. In view of the contribution that energy efficiency savings can make to a reduction in the demand of energy (especially electricity) and a resulting reduction in emissions (given the fossil fuel-intensive nature of energy production in South Africa), it is deemed appropriate to encourage greater levels of energy efficiency savings.

Proposal

278. It is proposed that taxpayers be entitled to claim an allowance for all forms of energy efficiency savings resulting from activities in the production of income. This allowance will enable taxpayers to capture the full profit from energy-efficient savings during each year in which incremental energy efficiency savings are initially realised. The allowance for each year of incremental savings will be set at 45 cents per kWh equivalent.

279. Energy efficiency savings will be verified by an accredited measurement and verification professional, using standardised baseline methodology. All forms of energy efficiency savings will be taken into account and will be expressed in kWh equivalent in order to achieve uniformity. Energy efficiency savings will be determined by measuring energy use against an initial baseline, as set by a measurement and verification professional.

280. The energy efficiency savings certificate is the key prerequisite for the energy efficiency savings allowance. The certificate must contain the predetermined energy use baseline, the annual energy efficiency savings (stated in kWh equivalent), and the revised baseline. All this information must be authenticated and issued by the South African National Energy Development Institute (SANEDI).

281. All the criteria and methodology used to determine the baseline and energy efficiency savings must be in terms of regulations issued by the Minister of Finance after consultation with the Minister of Energy and the Minister of Trade and Industry. The regulations will be based on the South African National Standard 50010 (SANS 50010, Measurement and Verification of Energy

Savings), issued by the South African Bureau of Standards.

Effective date

282. The tax incentive will come into operation on a date to be determined by the Minister of Finance by notice in the *Government Gazette*.

Annexure D: Benchmarking

What is benchmarking?

283. A benchmark is defined simply as a performance measure typically set at a specific reference level. It depends on the goal level used to dictate performance by a specific plant, industry or subsector to identify possibilities for improvement or for rewarding performance, set baselines in new market mechanisms, and/or determine investments (Litz, 2012). Benchmarks are based on industry best practices and reflect the emissions levels from highly efficient, lower-emitting facilities in each industry sector. As benchmarks normally use averages, they allow industry to pursue the most cost-effective abatement options.

284. Benchmarks are incorporated to help polices for underlying GHG emissions reductions to maximise the economic efficiency of emissions reductions attained; to avoid emissions leakage; and/or to manage cost burdens in an equitable manner (SEI, 2010). In particular, for market-based approaches, benchmarking through allowance allocation sends correct price signals to individual facilities and incentivises them to lower their emissions, although there is no control on the level of abatement.

285. A simple formula for a GHG benchmark would be as follows:

$$GHG\ benchmark = \frac{Emissions\ (tons\ CO_2\ equivalent)}{Unit\ of\ output\ (tons,\ \$,\ or\ other\ metric)}$$

286. Benchmarking enables the assessment of GHG emissions performance across facilities, or against a common standard, which is often expressed as quantities of GHG released per ton of output.

How to set a benchmark

287. The main issues to be considered when developing a benchmark include the following:

- Clarifying how the benchmarked sector is to be defined
- Establishing measurement protocols and boundaries
- Identifying units for normalising the benchmark
- Selecting the level for setting the benchmark
- Performing an initial assessment of possible data sources.

288. The definition of a sector or industry-specific benchmark largely depends on the level of aggregation across subsectors. Industry benchmarks provide adaptation flexibility, as the industry can restructure its processes over a wider range of activities in the production or supply chain, compared with concentrating on specific sector activities. Specificity or aggregation benchmarks might, however, not be appropriate for unique products. Product benchmarks can be developed for specific products (the “one product, one benchmark” principle), irrespective of the production technology.

289. The measurement protocol and boundaries look at whether only direct emissions or all emissions, including heat generation emissions, will be considered. For consistency, the same

protocol used to construct the benchmark needs to be applied in monitoring the emissions to which the benchmark applies.

290. Normalising units for a benchmark implies establishing whether tons of output, rands of output, or tons of input will be used in expressing benchmarks in physical units. The benchmark level looks at whether an average, better-than-average or best available metric is applicable in determining the benchmark. The benchmark level helps to show the best performing plants, and can be used to determine goals and design incentives to help less-efficient plants to improve their performance.

291. As credible benchmarks can only be created using robust data, it is important to determine the reliable data sources available before embarking on the benchmark-setting exercise. Potential data sources include industry groups or associations, government surveys and mandatory GHG reporting rules. Although benchmarks rely on similar data sources, the underlying policy context (market-based approaches, voluntary or regulatory) affects the design in terms of the ambition and level of the benchmark. Overall, a benchmark should be simple and transparent, so that its results are undisputable and unambiguous, where the same rules apply to all and a suitable fall-back approach is in place.

Types of benchmarks

292. Benchmarks have been used in all the leading policy approaches to reducing industrial GHG emissions, including voluntary performance goals, market-based approaches (tax or cap-and-trade) and emissions performance standards. Voluntary industry efforts to benchmark and reduce GHG emissions have been undertaken at the international, national and local levels. There are two main efforts on the international scene:

- In the Cement Sustainability Initiative (CSI) main players in the global cement industry contribute data from individual facilities on emissions per ton of cement (or clinker) to a third-party for comparing their performance against that of other plants or average or high-performing plants.
- The International Aluminium Institute (IAI) collects and shares data on PFC emissions from the international aluminium industry, and establishes goals for global emissions reduction, especially around PFCs.

293. For market-based approaches, the benchmark is the average emissions intensity of a sector. The benchmark is used to calculate how many allowances each individual facility receives based on its emissions output times the benchmark. The benchmark will therefore be expressed in units of emissions per physical output (e.g. tons):

$$\text{Benchmark value (tCO}_2\text{ per ton product)} \times \text{Production (tons)} = \text{Allocation (allowances)}$$

294. Facilities whose emissions intensity is above average (that is, more efficient or lower-emitting facilities) receive more allowances than they would need to cover their emissions. Hence, they would have extra allowances to sell to less efficient (higher-emitting) facilities. In the EU, benchmarks are based on the performance of the 10 per cent most efficient installations in 2007 and 2008 (EU, 2008).

295. Regulatory emission performance standards are mainly administered either by identifying particular sector-specific emissions benchmarks that should not be exceeded, or by defining particular technological controls, such as the best available control technology (BACT) that each facility must implement. The regulatory emission performance standards can sometimes be regarded as a "backstop" policy should market-based approaches fail to be implemented (SEI, 2010).

296. In order to address the difficulty in setting benchmarks for every product (e.g. due to dissemination of products or too few emissions from the production process), fall-back approaches or other benchmarks have been suggested, including for heat and fuel. Additionally, for sites with several sub-installations or where production processes evolve, a dynamic benchmark will be required, which makes it challenging to administer it. For a market-based policy, only the product benchmark fully exploits efficiency, as it takes into account final energy consumption, energy conversion efficiency and fuel choice, compared with the fuel or heat benchmarks (Fallman, 2012).

297. Different industries face different challenges but major benchmark design decisions (such as level, scope and boundaries), data sources and aggregation level will depend on the policy being pursued and the statutory constraints. GHG benchmarking faces particular challenges in terms of the treatment of cogeneration heat, use of recycled feedstock, multiproduct facilities, facility integration and the way in which the final product is defined (Greenwald, 2012).

South Africa specific benchmarks

298. During the consultation on the carbon tax draft paper, a questionnaire was sent to industries to report on whether their sector or specific production or manufacturing process had local or international GHG emissions intensity benchmarks. This information was sought in view of the tax design, particularly the use of benchmarks for emissions intensity to inform threshold exemptions. Mixed responses were received from South African industries, but the overall recommendation was that benchmarks should be applied with caution. There is a need to take account of the different processes and company operations, especially considering the structure of the South African economy. Preference was shown for sector-specific lifecycle-based benchmarks, as opposed to production facility benchmarks. (The estimated emission intensities for the different sectors and processes shown in Table 9.) For comparison, the EU ETS – which has the most advanced benchmarks given its experience with allowance allocation – is reviewed below.

299. The EU ETS has 52 product benchmarks covering approximately 75 per cent of industrial ETS emissions (Neelis, 2012). The "one product, one benchmark" principle applies, and product benchmarks cover the complete production process where the average of the best 10 per cent performing installations are used in determining benchmarks. Table 14 lists some benchmark figures that were developed as a first blueprint of an allocation methodology for free allocation of emissions allowances under the EU ETS for the period 2013–20 (Ecofys, 2009). As a blueprint report, several open issues exist, and these are highlighted in the benchmark values of the respective sectors.

Table 14: Summary of proposed preliminary benchmarks for the third phase of the EU ETS

Sector	Product	Classification	Benchmark values[1]
Mineral oil refineries	CO_2 per complexity weighted ton (CWT)	Solomon	*0.030 tCO_2/CWT*[2]
Iron and steel industry	Coke	PC	0.090 tCO_2/t
	Sinter	PC	0.119 tCO_2/t
	Hot metal	Industry	1.286 tCO_2/t
	Electric arc furnace: non-alloy, high alloy and other alloy	PC	0.058 tCO_2/t
Aluminium	Alumina	PC	0.390 tCO_2/t
	Pre-baked anodes	Industry	0.330 tCO_2/t
	Primary aluminium	PC	*1.570 tCO_2/t*[3]
	Secondary aluminium	PC	*0.220 tCO_2/t*[3]
Cement	Clinker	PC	*0.780 tCO_2/t*[4]
Lime	Lime	PC	0.985 tCO_2/t
	Dolime	PC	1.113 tCO_2/t
Glass	Flat glass	PC	0.606 tCO_2/t
	Hollow glass	PC	0.250 tCO_2/t
	Continuous filament fibre	PC	1.003 tCO_2/t
Ceramic products	Low and high-density clay blocks	PC + Industry	*0.114 tCO_2/t*[5]
	Facing bricks and pavers	PC + Industry	*0.133 tCO_2/t*[5]
	Roof tiles	PC + Industry	*0.151 tCO_2/t*[5]
	Spray-dried powder	PC + Industry	0.055 tCO_2/t
	Dry-pressed wall and floor tiles	PC + Industry	0.300 tCO_2/t
	High heat-resistant refractory products	PC + Industry	0.335 tCO_2/t
	Low heat-resistant refractory products	PC + Industry	0.225 tCO_2/t
Gypsum	Raw gypsum / land plaster	Industry	0.010 tCO_2/t
	Plaster	PC	0.050 tCO_2/t
	Gypsum blocks, plaster boards, coving	PC	0.080 tCO_2/t
	Glass fibre-reinforced gypsum	PC	0.180 tCO_2/t
Pulp and paper	Kraft pulp	PC	0.048 tCO_2/t
	Sulphite pulp, (chemi-) thermo-mechanical and mechanical pulp	PC	0.000 tCO_2/t
	Recovered paper	Industry	0.019 tCO_2/t
	Newsprint	PC	0.318 tCO_2/t
	Uncoated fine paper	PC	0.405 tCO_2/t
	Coated fine paper	PC	0.463 tCO_2/t
	Tissue	PC	0.343 tCO_2/t
	Containerboard	PC	0.368 tCO_2/t
	Carton board	PC	0.418 tCO_2/t
Chemical industry	Nitric acid	PC	1.210 kg N_2O/t
	Ammonia	PC	1.460 tCO_2/t
	Adipic acid	PC	5.600 tCO_2-eq/t
	Hydrogen / synthesis gas	PC	*0.03 tCO_2/CWT*[2]
	Soda ash	PC	0.730 tCO_2/t
	Aromatics	PC	*0.030 tCO_2/CWT*[2]

	Carbon black	PC	*2.620 tCO_2/t*[6]

Notes: PC = product classification.

1. Values in italics indicate that the value is based on a benchmark curve or a literature value that is not fully consistent with the methodology proposed in the first blueprint study of an allocation methodology for free allocation of emissions allowances under the EU ETS for 2013–20.
2. The value should be regarded as preliminary because it is unclear how specialty refineries have been treated and how the average of the 10 per cent most efficient refineries have exactly been determined.
3. The benchmark includes emissions from electricity calculated with an emissions factor of 0.75 kg CO_2 per kWh, instead of 0.465 kg CO_2 per kWh.
4. Values based on a process emissions factor of 538 kg CO_2 per ton of clinker instead of 523 kg CO_2 per ton of clinker, which would be in line with the EU ETS monitoring and reporting guidelines.
5. The benchmark value is based on linearisation of the 10th to 90th percentile of installations.
6. Value without a deduction for the calorific value of tail gas.

Source: Adapted from Ecofys (2009: 67–72).

Annexure E: Carbon Offsets

What are carbon offsets?

300. A carbon offset is an (external) investment through which a firm can access GHG mitigation options that are cheaper than what can be achieved by investment in its own operations. The funding of mitigation measures implemented by other entities (Promethium Carbon, 2012). Carbon offsets typically involve specific projects or activities that reduce, avoid, or sequester emissions; i.e. project-based (Ramseur, 2007).

301. Carbon offset projects are developed and evaluated under specific methodologies and standards, which enable the issuance of carbon credits. Depending on the type of methodology being used for the development of carbon credits, they can be sold in the voluntary and compliance carbon markets.

302. Carbon offset projects can be categorised by a set of characteristic, including the technology employed or type of GHG reduction, as well as specific methodology selected to develop the project. Four different categories of offsets are most frequent: biological sequestration, renewable energy, energy efficiency, and reduction of non-CO_2 emissions (Ramseur, 2007).

Design criteria and type of offset projects that could be considered

303. The principles of 'real, reliable, additional and permanent' are pivotal to ensuring the credibility of carbon offset projects. In addition incorporating and monitoring sustainable development aspects of offsetting projects throughout their lifetime should be given due attention.

304. ***Real -*** develop or use available methodologies that ensure that carbon emissions are measurable and quantifiable and take into account adjustments for uncertainty and leakage. ***Reliable -*** an independent, third party, to audit a project. This includes both a validation of a projects design before it is implemented, and then a constant verification process at set intervals following the generation of emission reductions. ***Additional -*** its intent is to prove that a carbon offsetting project is being implemented above what would have happened under a 'business as usual' scenario. Project needs to demonstrate that its main aim is to reduce emissions, in a manner that would not have occurred under a business as usual situation. ***Permanent -*** relates to the long term removal, reduction or avoidance of carbon (or carbon dioxide equivalent) emissions. This applies to projects with the risk of reversibility, especially in the case of land based projects, which face risks such as fire and disease. ***Supporting Sustainable Development -*** within a carbon offset projects relates to the incentivising of co-benefits (positive externalities) from the development of projects (Camco Clean Energy, 2012).

305. Eligible projects could include: Agriculture, forestry and other lad uses (AFOLU), waste, community based and municipal energy efficiency and renewable energy, electricity transmission and distribution efficiency, small scale renewable energy (up to 15 MW) and transport projects.

306. Ineligible projects could include industrial gas destruction projects, e.g. HFC-23 and Nitrous Oxide destruction projects. In addition projects that could potentially result in a double

incentive will not be allowed; energy efficiency in company owned or controlled operations that are covered by the carbon tax; embedded or cogeneration of renewable energy for company owned or controlled operations that are covered by the carbon tax. This includes parasitic electricity usage by fossil fuel based power stations; fuel switch projects in company owned or controlled operations that are covered by the carbon tax; and energy efficient coal-fired power stations. Measures to avoid potential collusion between companies to circumvent the restriction on "company owned or controlled operations" will be introduced (Camco Clean Energy, 2012).

307. The eligibility of renewable energy project developed under the Renewable Energy Independent Power Producer Programme (REIPPP) and large-scale renewable energy 'Programme of Activities' (PoA) as registered under the CDM (above 15 MW) will be considered subsequent to the consultation process.

308. It is envisaged that entities will initially be permitted to use verified carbon offsets developed in South Africa, under internationally recognised carbon offsetting standards (e.g. Clean Development Mechanism (CDM), Verified Carbon Standard (VCS) or Gold Standard (GS)). Development of a South Africa specific standard will be considered at a later stage.

309. It is proposed that carbon offsets can be used by firms to reduce their carbon tax liability by up to 5 or 10 per cent of the actual emissions.

Potential benefits of carbon offsetting

310. The purchase of carbon offsets will enable entities to lower their carbon tax liability. Use of carbon offsets will also incentivise investment in least cost mitigation options by investments in GHG mitigation projects that deliver carbon emission reduction at a R/CO_2e cost lower than the carbon tax.

311. The investment in low carbon projects will not only cost effectively reduce carbon emissions and contribute towards national mitigation targets, but will also encourage a greater uptake of cleaner energy technologies, energy-efficiency measures and promote research and development into low carbon solutions (Promethium Carbon, 2012).

312. Carbon offset projects can also potentially generate sustainable development benefits within South Africa, including channelling capital to projects that facilitate rural development, create employment, restore landscapes, reduce land degradation, protect biodiversity, and encourage energy efficiency and low carbon growth (Camco Clean Energy, 2012).

313. A draft paper elaborating on design features for the offset mechanism will be published as a separate paper. It will elaborate on carbon offset standards that will be permitted under the carbon tax; project types and methodologies; origins of offset projects; and provide considerations regarding the institutional design and operation of the carbon offset mechanism.

References

Alton, T, Channing, A, Davies, R et al., 2012. *The economic implications of introducing carbon taxes in South Africa*. UNU-WIDER Working Paper No. 2012/46, May 2012. National Treasury and United Nations University–World Institute for Development Economics Research. Available at: http://www.wider.unu.edu/publications/working-papers/2012/en_GB/wp2012-046/

Arndt, C, Davies, R & Thurlow, J, 2011. *Energy extension to the South African General Equilibrium (SAGE) Model (Version 2.0).* Helsinki: UNU-WIDER. Unpublished mimeo.

Australia, 2008. *Carbon Pollution Reduction Scheme: Australia's Low Pollution Future.* White Paper, Volume 1, December 2008. Commonwealth of Australia. Available at: http://www.climatechange.gov.au/publications/cprs/white-paper/cprs-whitepaper.aspx

Camco Clean Energy, November 2012. *Use of Carbon Offsets under a South African Carbon Tax Regime.*

Callan, T, Lyons, S, Scott, S et al., 2008. *The distributional implications of a carbon tax in Ireland.* Economic and Social Research Institute (ESRI) Working Paper 250, July 2008. Dublin: ESRI. Available at: http://www.esri.ie/UserFiles/publications/20080723152521/WP250.pdf

Chartered Accountants Ireland (CAI), 2012. *Carbon tax increase takes effect tomorrow*. 30 April 2012. Available at: http://www.charteredaccountants.ie/en/General/News-and-Events/News1/2012/April-/Carbon-Tax-Increase-Takes-Effect-Tomorrow/

Convery, F, 2012. *Budget 2013 – Three cheers for the carbon tax.* September 2012. Available at: http://www.publicpolicy.ie/budget-2013-three-cheers-for-the-carbon-tax/

De Mooij, RA, Parry, IWH & Keen, M (Eds), 2012. *Fiscal policy to mitigate climate change: A guide to policymakers.* Washington DC: International Monetary Fund. Available to subscribers at: http://www.elibrary.imf.org/view/IMF071/12762-9781616353933/12762-9781616353933/12762-9781616353933.xml?rskey=qNfCiT&result=1&q=mooij parry keen

Department of Energy (DoE), 2011. *Integrated Resource Plan for Electricity, 2010–2030*. Pretoria: DoE. Available at: http://www.doe-irp.co.za/content/IRP2010_promulgated.pdf

Department of Energy (DoE), 2013. *Designated National Authority: SA CDM Projects Portfolio.* Available at: http://www.energy.gov.za/files/esources/kyoto/kyoto_sa.html

Department of Environment Affairs and Tourism (DEAT), 2009. *Greenhouse Gas Inventory South Africa, 1990 to 2000.* National Inventory Report, May 2009. Pretoria: DEAT. Available at: http://rava.qsens.net/themes/theme_emissions/government-publications/SA%20GHG%202000.pdf

Department of Environmental Affairs (DEA), 2008. *People – Planet – Prosperity: A National Framework for Sustainable Development in South Africa.* July 2008. Pretoria: DEA. Available at: http://www.info.gov.za/view/DownloadFileAction?id=175921

Department of Environmental Affairs (DEA), 2011a. *National Climate Change Response White Paper.* Pretoria: DEA, Available at: http://www.environment.gov.za/sites/default/files/legislations/national_climatechange_response_whitepaper.pdf

Department of Environmental Affairs (DEA), 2011b. *National Strategy for Sustainable Development and Action Plan (NSSD 1), 2011–2014.* November 2011. Available at: http://www.environment.gov.za/sites/default/files/docs/sustainabledevelopment_actionplan_strategy.pdf

Department of Minerals and Energy (DME), 1998. *White Paper on the Energy Policy of the Republic of South Africa.* December 1998. Available at: http://www.info.gov.za/whitepapers/1998/energywp98.htm

Department of Minerals and Energy (DME), 2003a. *Integrated Energy Plan for the Republic of South Africa.* March 2003. Pretoria: DME. Available at: http://www.info.gov.za/view/DownloadFileAction?id=124574

Department of Minerals and Energy (DME), 2003b. *White Paper on the Renewable Energy Policy of the Republic of South Africa.* November 2003. Available at: http://www.info.gov.za/view/DownloadFileAction?id=68765

Department of Minerals and Energy (DME), 2005. *Energy Efficiency Strategy of the Republic of South Africa.* March 2005. Pretoria: DME. Available at: http://www.info.gov.za/view/DownloadFileAction?id=88503

Department of Minerals and Energy (DME), 2007a. *Energy Security Master Plan – Electricity, 2007–25.* Pretoria: DME. Available at: http://www.info.gov.za/view/DownloadFileAction?id=77936

Department of Minerals and Energy (DME), 2007b. *Energy Security Master Plan – Liquid Fuels.* Pretoria: DME. Available at: http://www.info.gov.za/view/DownloadFileAction?id=73542

Department of Minerals and Energy (DME), 2008. *National Energy Efficiency Strategy of the Republic of South Africa.* October 2008. Pretoria: DME. Available at: http://www.info.gov.za/view/DownloadFileAction?id=103163

Department of Trade and Industry (DTI), 2010. *Industrial Policy Action Plan (IPAP) 2010/11 – 2012/13.* February 2010. Pretoria: DTI. Available at: http://www.info.gov.za/view/DownloadFileAction?id=117330

Devarajan, S, Go, DS, Robinson, S & Thierfelder, K, 2009. *Tax policy to reduce carbon emissions in South Africa*. World Bank Working Paper 4933, May 2009. Available at: http://elibrary.worldbank.org/content/workingpaper/10.1596/1813-9450-4933

Ecofys, 2009. *Methodology for the free allocation of emission allowances in the EU ETS post 2012.* Report on the project approach and general issues, November 2009. Available at: http://ec.europa.eu/clima/policies/ets/cap/allocation/docs/bm_study-project_approach_and_general_issues_en.pdf

Economic Development Department (EDD), 2010. *The New Growth Path: The Framework.* Pretoria: EDD. Available at: http://www.info.gov.za/view/DownloadFileAction?id=135748

Ecosystems Market Place and Bloomberg New Energy Finance, 2012. Developing Dimension: State of the Voluntary Carbon Markets 2012. Available at: http://about.bnef.com/white-papers/developing-dimension-state-of-the-voluntary-carbon-markets-2012/

Energy Research Centre (ERC), 2007. *Long-Term Mitigation Scenarios: Scenario Document.* Prepared for the Department of Environment Affairs and Tourism (DEAT) by the Scenario-building Team. Pretoria: DEAT, October 2007. Available at: http://www.erc.uct.ac.za/Research/publications/07Scenario_team-LTMS_Scenarios.pdf

Esty, DC & Charnovitz, S, 2012. Green rules to drive innovation. *Harvard Business Review,* 1 March 2012. Available to subscribers at: http://hbr.org/2012/03/green-rules-to-drive-innovation/ar/1

European Union (EU), 2008. *Directive 2003/87/EC of the European Parliament and of the Council* (as amended). Available at: http://europa.eu/legislation_summaries/energy/european_energy_policy/l28012_en.htm#amendingact

Fallmann, H, 2012. *Benchmarking: Theoretical key considerations.* Presentation at the Joint International Carbon Action Partnership / North America 2050 Initiative (ICAP/NA2050) Public Workshop on Developing Industrial Benchmarks. Pace University, New York, 24 September 2012. Available at: http://www.c2es.org/docUploads/Fallmann%20Benchmarking%20Presentation.pdf

Gargan, R, 2012. *Reflections on the implementation of the carbon tax in Ireland.* Presentation to the University College Dublin/National Economic and Social Council Workshop on Climate Change, 16 May 2012. Available at: http://www.nesc.ie/assets/files/downloads/project_climate%20change/ucd_workshop/ericgargan.pdf

Greenwald, J, 2012. *Conclusions and outlook.* Presentation at the Joint International Carbon Action Partnership / North America 2050 Initiative (ICAP/NA2050) Public Workshop on Developing Industrial Benchmarks. Pace University, New York, 24 September 2012. Available at: http://www.c2es.org/docUploads/Greenwald%20Benchmarking%20Presentation.pdf

Incite, 2010. *Carbon Disclosure Project 2010: South Africa JSE 100*. Report written by Incite Sustainability, in corporation with the National Business Initiative. Available at: https://www.cdproject.net/CDPResults/CDP-2010-South-Africa-JSE100.pdf

India, 2008. *National Action Plan on Climate Change.* Prime Minister's Council on Climate Change, Republic of India. Available at: http://pmindia.gov.in/climate_change_english.pdf

Intergovernmental Panel on Climate Change (IPCC), 2006. *2006 IPCC guidelines for national greenhouse gas inventories.* IPCC National Greenhouse Gas Inventories Programme, Institute for Global Environmental Strategies, Hayama Kanagawa, Japan. Available at: http://www.ipcc-nggip.iges.or.jp/public/2006gl/index.html

Intergovernmental Panel on Climate Change (IPCC), 2007. *Climate Change 2007: Synthesis Report.* Geneva: IPCC. Available at: http://www.ipcc.ch/publications_and_data/publications_ipcc_fourth_assessment_report_synthesis_report.htm

International Energy Agency (IEA), 2011. *Summing up the parts: Combining policy instruments for least-cost climate mitigation strategies.* Information paper, September 2011. Paris: IEA.. Available at: http://www.iea.org/publications/freepublications/publication/Summing_Up.pdf

Ireland, 2009. *Commission on Taxation Report 2009.* Republic of Ireland. Available at: http://www.commissionontaxation.ie/Report.asp

Jooste, M, Winkler, H, Van Seventer, D & Truong, PT, 2009. *The effect of response measures to climate change on South Africa's economy and trade*. Final report to the Department of Environmental Affairs (DEA), December 2009. University of Cape Town: Energy Research Centre (ERC). Available at: http://www.erc.uct.ac.za/Research/publications/09Joosteetal-Response_Measures.pdf

Kearney, M, 2008. *Modeling the impact of CO_2 taxes in combination with the Long-Term Mitigation Scenarios on emissions in South Africa using a dynamic computable general equilibrium model*. University of Cape Town: Energy Research Centre (ERC). Available at: http://www.erc.uct.ac.za/Research/publications/08Kearney-Dynamic_CGE_on_LTMS.pdf

KPMG Advisory (China) Limited, 2011. *China's 12th Five-Year Plan (2011–2015).* KPMG Insight Series, March 2011. Available at: http://www.kpmg.com/cn/en/issuesandinsights/articlespublications/publicationseries/5-years-plan/pages/default.aspx

Krugman, P, 2010. Building a green economy. *The New York Times Magazine*, 5 April. Available at: http://www.nytimes.com/2010/04/11/magazine/11Economy-t.html?pagewanted=all

Litz, FT, 2012. *Why benchmarking?* Presentation at the Joint International Carbon Action Partnership / North America 2050 Initiative (ICAP/NA2050) Public Workshop on Developing Industrial Benchmarks. Pace University, New York, 24 September 2012. Available at: http://www.c2es.org/docUploads/Litz%20Benchmarking%20Presentation.pdf

Martin, R & Kemper, A, 2012. Saving the planet: A tale of two strategies. *Harvard Business Review,* April, 48–56. Available to subscribers at: http://hbr.org/2012/04/saving-the-planet-a-tale-of-two-strategies/ar/1

National Council for Air and Stream Improvement Inc. (NCASI), 2005. *Calculation tools for estimating greenhouse gas emissions from pulp and paper mills*. Report version 1.1, July 2005. North Carolina: NCASI. Available at:
http://www.ncasi.org/support/downloads/Detail.aspx?id=28

National Treasury (NT), 2010. *Reducing greenhouse gas emissions: The carbon tax option.* Discussion Paper, December 2010. Pretoria: National Treasury. Available at:
http://www.treasury.gov.za/public%20comments/Discussion%20Paper%20Carbon%20Taxes%2081210.pdf

Neelis, M, 2012. *Benchmarking in the EU ETS.* Presentation at the Joint International Carbon Action Partnership / North America 2050 Initiative (ICAP/NA2050) Public Workshop on Developing Industrial Benchmarks. Pace University, New York, 24 September 2012. Available at:
http://www.c2es.org/docUploads/Neelis%20Benchmarking%20Presentation.pdf

Neuhoff, K, 2008. *Tackling carbon: How to price carbon for climate policy.* Faculty of Economics, University of Cambridge. Available at:
http://www.eprg.group.cam.ac.uk/wp-content/uploads/2009/03/tackling-carbon_final_3009082.pdf

Partnership for Market Readiness (PMR), 2012. *PMR Technical Workshop #3: Baseline Setting and Registry Set Up.* Workshop summary, Cologne, Germany, 27 May 2012. Available at:
http://www.thepmr.org/events/eventlist/workshop/technical-workshop-3-baseline-setting-registry-set-cologne

Pauw, K, 2007. *Economy-wide modeling: An input into the Long-Term Mitigation Scenarios* process. LTMS Input Report 4 prepared for the Department of Environment Affairs and Tourism (DEAT), October 2007. University of Cape Town: Energy Research Centre (ERC). Available at:
http://www.erc.uct.ac.za/Research/publications/07-Pauw-LTMSEconomy-wide_modelling.pdf

People's Republic of China (PRC), 2011. *Report on the Implementation of the 2010 Plan for National Economic and Social Development and on the 2011 Draft Plan for National Economic and Social Development.* Fourth Session of the 11th National People's Congress, 5 March 2011. Available at:
http://news.xinhuanet.com/english2010/china/2011-03/17/c_13783842.htm

Promethium Carbon, September 2012. *Initial Framework for Carbon Offset Opportunities and Verification Options.* Available at:
http://www.promethium.co.za/wp-content/uploads/2012/10/2012-09-10-BUSA-JSE-carbon-offset-study-draft.pdf

Ramseur J. L. Voluntary Carbon Offsets: Overview and Assessment. U.S. Congressional Research Service, 2007. Available at:
http://fpc.state.gov/documents/organization/96418.pdf

South Africa, 2011. Address by President Jacob Zuma during the World Climate Business Summit on Green Business Generation, Elangeni Hotel, Durban, 3 December 2011. Available at:
http://www.thepresidency.gov.za/pebble.asp?relid=5392

Stern, N, 2006. *Stern Review on the economics of climate change.* London: HM Treasury; Cambridge: Cambridge University Press. Available at:
http://www.hm-treasury.gov.uk/stern_review_report.htm

Stockholm Environment Institute (SEI), 2010. *White Paper: Issues and Options for Benchmarking Industrial GHG Emissions.* Report submitted to the Washington State Department of Ecology, 30 June 2010. Available at:
http://www.ecy.wa.gov/climatechange/docs/Benchmarking_White_Paper_Final.pdf

United Nations Environment Programme (UNEP), 2010. *Driving a green economy through public finance and fiscal policy reform.* Working Paper v. 1.0. Nairobi: UNEP. Available at:
http://www.unep.org/greeneconomy/Portals/88/documents/ger/GER_Working_Paper_Public_Finance.pdf

United Nations Framework Convention on Climate Change (UNFCCC), Article 1, 1992, Available at:
http://unfccc.int/essential_background/convention/background/items/1350.php

Van Heerden, J, Gerlagh, R, Blignaut, J et al., 2006. Searching for triple dividends in South Africa: Fighting CO_2 pollution and poverty while promoting growth. *The Energy Journal,* 27(2): 113–142. Available to subscribers at:
http://www.iaee.org/en/publications/ejarticle.aspx?id=2128

Vivid Economics, 2012. *Carbon taxation and fiscal consolidation: The potential of carbon pricing to reduce Europe's fiscal deficits.* Report prepared for the European Climate Foundation and Green Budget Europe, May 2012. Available at:
http://www.foes.de/pdf/2012-05_CETRiE_Carbon_Pricing_Report_web.pdf

Winkler, H, Jooste, M & Marquard, A, 2010. Structuring approaches to pricing carbon in energy and trade intensive sectors: Options for South Africa. In Winkler, H, Marquard, A & Jooste, M (Eds), *Putting a price on carbon: Economic instruments to mitigate climate change in South Africa and other developing countries.* Conference proceedings. Energy Research Centre (ERC), University of Cape Town, 23–24 March 2010, pp. 127–150. Available at:
http://www.erc.uct.ac.za/Research/publications/10Winkler-et-al_ERC_Conference_Proceedings.pdf

World Bank, June 2012. *State and Trends of the Carbon Market 2012.* Available at:
http://siteresources.worldbank.org/INTCARBONFINANCE/Resources/State_and_Trends_2012_Web_Optimized_19035_Cvr&Txt_LR.pdf

World Bank Group, International Monetary Fund IMF, Organisation for Economic Cooperation and Development (OECD) and Regional Development Banks. *Mobilizing Climate Finance.* A Paper prepared at the request of G20 Finance Ministers, October 2011. Available at:
http://www.imf.org/external/np/g20/pdf/110411c.pdf