South Africa's 1st Annual Climate Change Report

Tracking South Africa's Transition to a Lower Carbon Economy

Theme D

environmental affairs
Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

IMPRINT

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The seven Themes of this Report are:

- ▷ **Theme A:** A Synopsis of South Africa's 2015 Annual Report on Monitoring Climate Change Responses
- ▷ **Theme B:** South Africa's Climate Change Monitoring and Evaluation System
- ▷ **Theme C:** Climate Change Trends, Risks, Impacts and Vulnerabilities
- ▷ **Theme D:** Tracking South Africa's Transition to a Lower Carbon Economy
- ▷ **Theme E:** Monitoring the Adaptation Landscape in South Africa: *Desired Adaptation Outcomes, Adaptation Projects and the Intended Nationally Determined Contribution*
- ▷ **Theme F:** Climate Finance
- ▷ **Theme G:** Climate Change Adaptation Governance and Management
- ▷ **Theme H:** Near-Term Priority Climate Change Flagship Programmes
- ▷ **Theme I:** Key Outcomes of COP 21

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FOREWORD BY MS. EDNA MOLEWA

MINISTER OF THE DEPARTMENT OF ENVIRONMENTAL AFFAIRS

Climate change is one of the greatest challenges of our time. As part of the global community, we know we shoulder an immense responsibility to deal with climate change and its impacts. The more we disrupt our climate, the more we risk severe, pervasive and irreversible impacts. That said - we do indeed have the means to limit climate change and build a more prosperous, sustainable future for our country and world, and all who live in it.

South Africa has endorsed the National Climate Change Response Policy as a vision and a framework for an effective climate change response, and the long-term, just transition to a climate-resilient economy and society. The policy is the product of an extensive consultation process. It sets two high-level objectives:

- ***Firstly***, to effectively manage the inevitable climate change impacts through interventions that build and sustain South Africa's social, economic and environmental resilience and emergency response capacity; and
- ***Secondly***, to make a fair contribution to the global effort to stabilise greenhouse gas (GHG) concentrations within a timeframe that enables economic, social and environmental development to proceed in a sustainable manner.

South Africa's approach towards an effective climate change response is both developmental and transformational. It is developmental in that we are prioritising climate change responses that have significant mitigation or adaptation benefits, AND have significant economic growth, job creation, public health, risk management and poverty alleviation benefits. It is transformational in that we are seeking to address climate change at a scale of economy that supports the required innovation and finance flows needed for a transition to a lower carbon, efficient, job creating, equitable and competitive economy. In essence, it is about sustainable development.

Work is well advanced in implementing this National Climate Change Response Policy. One of the key elements of the climate change response is a country-wide monitoring and evaluation system that tracks South Africa's transition to a lower carbon and climate resilient economy and society.

The main output of the climate change monitoring and evaluation system is South Africa's annual climate change report. This year, the Department will publish its first annual climate change report. This report focusses on (i) quantifying and profiling the impact of ongoing or recently completed mitigation actions (ii) updating the information on climate finance that was reported in South Africa's

first Biennial Update Report (iii) providing latest available information on climate change risks together with describing ongoing adaptation projects (iv) presenting progress in establishing a credible tracking system for key climate change actions in the country (v) updating the roadmap on climate change flagship programmes (vi) recognising and profiling climate change actions that have been taken by the local government sphere of government and (vii) setting out key outcomes of the 21st Conference of Parties (COP 21) which took place in Paris in December 2015.

Internationally, South Africa submitted its own Intended Nationally Determined Contribution (INDC) to the United Nations Framework Convention on Climate Change (UNFCCC) Secretariat in September 2015. Our INDC encompasses three distinct components namely mitigation, adaptation and the means of implementation. The main aim of the next annual report (2016/17) is to initiate an in-depth annual process of reporting progress against South Africa's INDC.

Lastly, there is vast potential for co-operation in producing these annual reports. We recognise and thank all those that have assisted us to produce the first report. For this report, we received contributions from all three spheres of government, the private sector, civil society, foreign embassies, and academia. In addition, I would like to thank the German government for the extensive support that we have received through GIZ. We invite many others to continue the collaboration with us as we contribute towards the identification of opportunities for further climate change actions and management of current and future climate risks with the view to consolidating the gains that this country has attained so far by improving peoples' livelihoods, conserving biodiversity, and improving human well-being. We believe that by working together; we can save our tomorrow today.

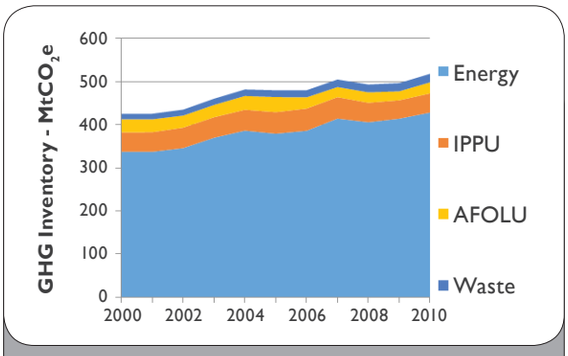
Thank you

MS. EDNA MOLEWA

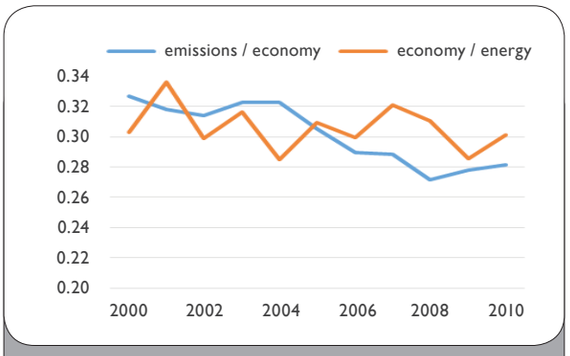
Minister of the Department of Environmental Affairs

DASHBOARD

National GHG emissions grew from 425 $MtCO_2e$ in 2000 to 518 $MtCO_2e$ in 2010

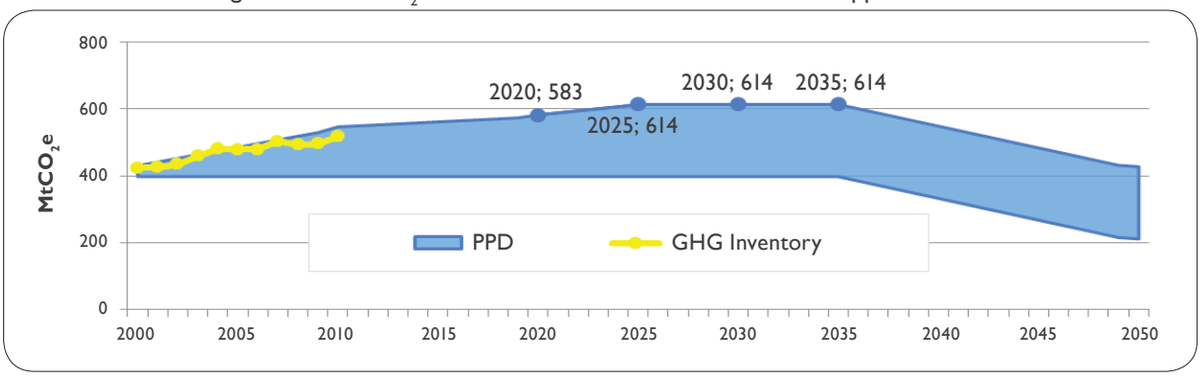


GHG emission growth rate of about 9$MtCO_2e$ per annum

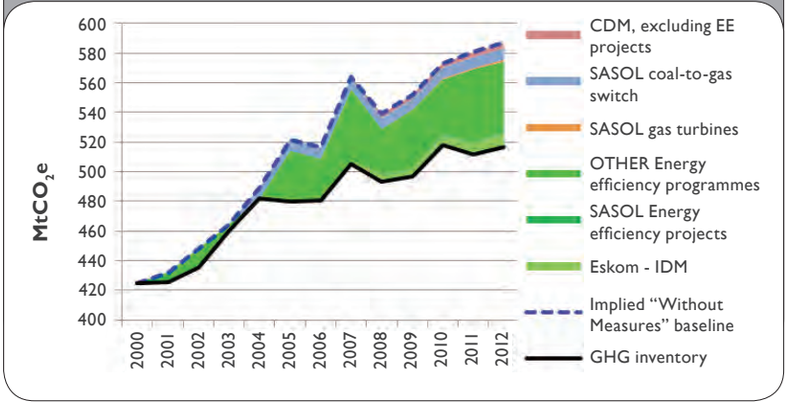


Minor decoupling of economic growth from GHG emissions

National carbon "budget" of 96 $MtCO_2e$ between 2010 emissions & 2025 PPD-upper limit



> 624 $MtCO_2e$ emissions reduced since 2000



2000–2014 estimates

- > **40,000** jobs created
- > **128,000** million litres of water saved

Air pollution avoided:

- > **770,000** tons SO_2
- > **400,000** tons NOx
- > **30,000** tons PM
- > **14 million** tons Ash

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LIST OF ABBREVIATIONS

AFOLU	Agriculture, Forestry and Other Land Use
BaU	business as usual
cCR	carbonn Climate Registry
CO2e	carbon dioxide equivalent
CDM	Clean Development Mechanism
CDP	Carbon Disclosure Project
CNG	compressed natural gas
DBSA	Development Bank of Southern Africa
DEA	Department of Environmental Affairs
DoE	Department of Energy
DPE	Department of Public Enterprises
DSM	demand-side management
DTI	Department of Trade and Industry
DFID	Department for International Development
DWS	Department of Water and Sanitation
EDD	Economic Development Department
EE	energy efficiency
EEDSM	Energy Efficiency and Demand Side Management Programme
EETMS	Energy Efficiency Target Monitoring System
EHCC	Earth Hour City Challenge
EPWP	Expanded Public Works Programme
GDP	gross domestic product
GFB	General Freight Business
Gg	gigagram
GHG	greenhouse gas
ICLEI	International Council for Local Environmental Initiatives
IDC	Industrial Development Corporation
IDM	Integrated Demand Management
IEE	Industrial Energy Efficiency Improvement (Project)
IPCC	Intergovernmental Panel on Climate Change
IPPU	industrial processes and product use
Kt	kilotonne
MCEP	Manufacturing Competitiveness Enhancement Programme
MDS	Market Demand Strategy
M&E	monitoring and evaluation
MRV	measuring, reporting and verifying
Mt	million tonnes
NBI	National Business Initiative
NCCRD	National Climate change response database
NCCRP	National Climate Change Response Policy, 2011
NCPC	National Cleaner Production Centre
NDP	National Development Plan
NOx	nitrogen oxides
NVG	natural gas vehicle
OCGT	Open Cycle Gas Turbine
PM	particulate matter
PPD	peak, plateau and decline
PV	photovoltaic
REIPPPP	Renewable Energy Independent Power Producer Procurement Programme
SAA	South African Airways
SAFCOL	South African Forestry Company Ltd.
SANEDI	South African National Energy Development Institute
SAWIS	South African Waste Information System
StatsSA	Statistics South Africa
SD	sustainable development
SO_2	sulphur dioxide
SWH	solar water heater
t	tonnes
TJ	terajoule
TPES	total primary energy supply
UNFCCC	United Nations Framework Convention on Climate Change

1. OVERVIEW

Both the National Climate Change Response Policy (NCCRP) (DEA 2011) and the National Development Plan (NDP) (NPC 2011) envision a South Africa with a lower-carbon economy. This theme presents the results of tracking South Africa's transition towards this envisaged lower-carbon economy from 2000 to 2014, particularly at the following two levels:

- The national level, tracking the country's overall transition. Here the thematic chapter assesses the changes in the country's greenhouse gas inventory, and how this compares with the changes in the country's energy consumption patterns, economic growth and population growth over the same period. This section also tracks the achieved progress towards the country's targets of a Peak, Plateau and Decline (PPD) trajectory and the Copenhagen target of a 34% and a 42% decrease in GHGs in 2020 and 2025 respectively compared to business-as-usual.
- Individual response measures, this section presents the outcomes, costs and impacts of major mitigation response measures that have been implemented since 2000. It showcases success stories at national, provincial and local government levels and in the private sector.

Delivering goods the low-carbon way

2. NATIONAL LEVEL INDICATORS

National level indicators are based on the following National Development Plan (NDP) vision of a lower-carbon economy:

- reduced dependency on carbon, natural resources and energy
- carbon emissions reduced to sustainable levels through mitigation policies
- economic activity decoupled from environmental degradation and carbon intensive energy
- expanding economic activity, while simultaneously decreasing consumption of non-renewable natural resources (NPC 2011)

2.1 Sustainable Carbon Levels

In 2010 the total greenhouse gas (GHG) emissions in South Africa were 544 $MtCO_2e$ (544 314 $GgCO_2e$). This excluded the land sub-sector, which sequestrated about 26 $MtCO_2e$ (26 076 $GgCO_2e$) GHGs. The net GHG emissions were thus 518 $MtCO_2e$ (518 239 $GgCO_2e$) (DEA 2014a).

South Africa's net GHG emissions grew at an average rate of 9.3 $MtCO_2e$ per annum in the period 2000–2010, due mainly to economic growth, to preparation for the 2010 Soccer World Cup and to an increase in demand for products and energy in line with population growth. **Figure 1** shows the annual GHG emissions for the period 2000–2010, disaggregated by sector (DEA 2014a).

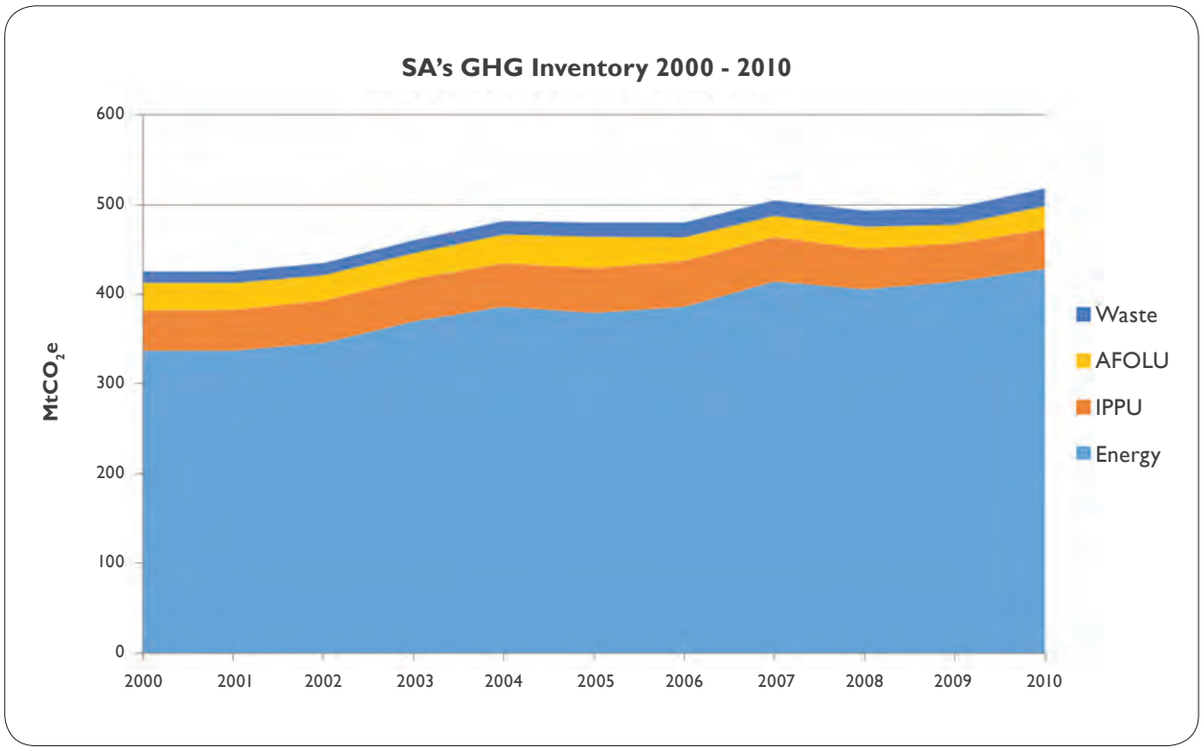


Figure 1: South Africa's greenhouse gas inventory for the period 2000–2010 *(DEA 2014a, 68)*

2.1.1 Emissions inventory in comparison with the PPD, the BAU trajectories and the INDC

Figure 2 shows the GHG inventory trajectory compared to the following key trajectories:

- The Peak, Plateau and Decline (PPD) trajectory as described in the National Climate Change Response Policy (NCCRP) (DEA 2011).
- The Business as Usual (BaU) trajectory as described in the NCCRP (DEA 2011).
- The Long-Term Mitigation Scenarios (LTMS) Growth Without Constraints (GWC) trajectory (SBT 2007).
- The two baseline scenarios of the Mitigation Potential Analysis (MPA) study: Without Measures (WoM) and With Existing Measures (WEM) (DEA 2014b, 13–16).

In 2010, South Africa's net emissions of 518 $MtCO_2e$ were within the PPD trajectory target of 398 $MtCO_2e$ (lower limit) and 547 $MtCO_2e$ (upper limit) for that year. Figure 2 shows that the remaining carbon "budget" between the 2010 GHG emission levels and the upper limit of the PPD trajectory in 2020 is 65 $MtCO_2e$, while for 2025 and 2030 the remaining budget is about 96 $MtCO_2e$. The 2025 and 2030 PPD targets of between 398 $MtCO_2e$ and 614 $MtCO_2e$ are also what South Africa submitted as its Intended Nationally Determined Contribution (INDC) for those years under the United Nations Framework Convention on Climate Change in 2015.

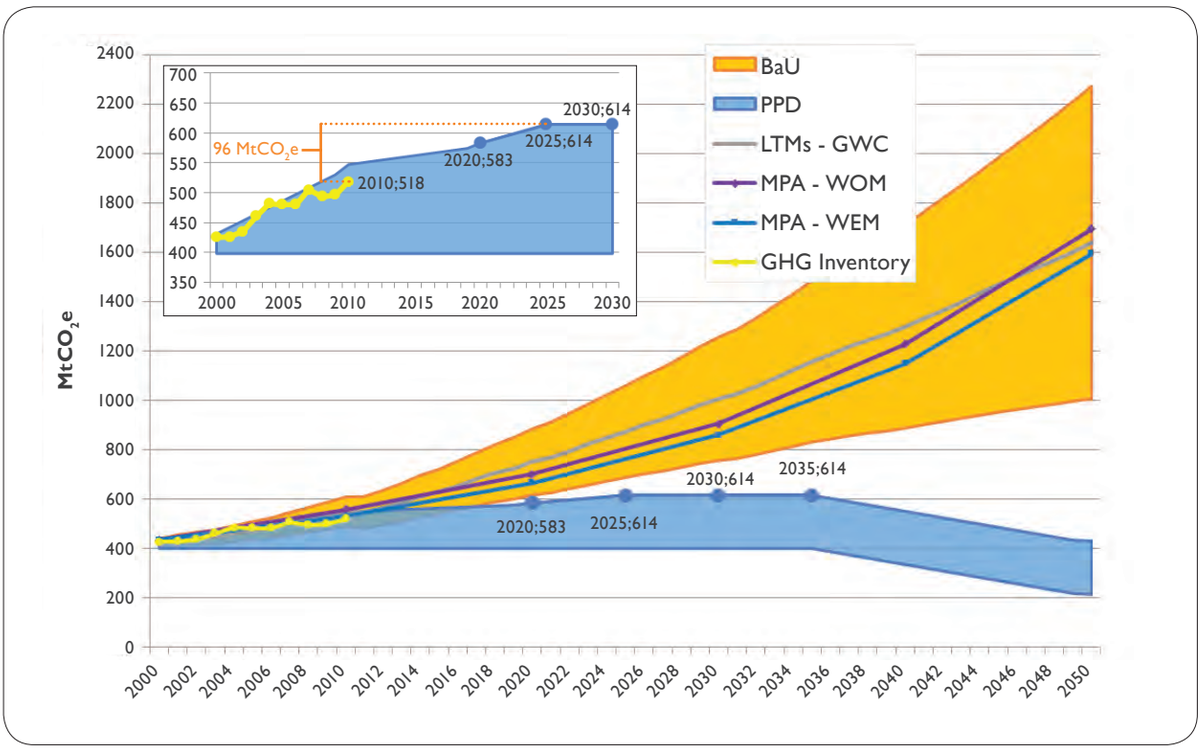


Figure 2: The national GHG inventory compared to the PPD and the BaU trajectories *(Data sources: DEA 2011; DEA 2014a; DEA 2014b and SBT 2007)*

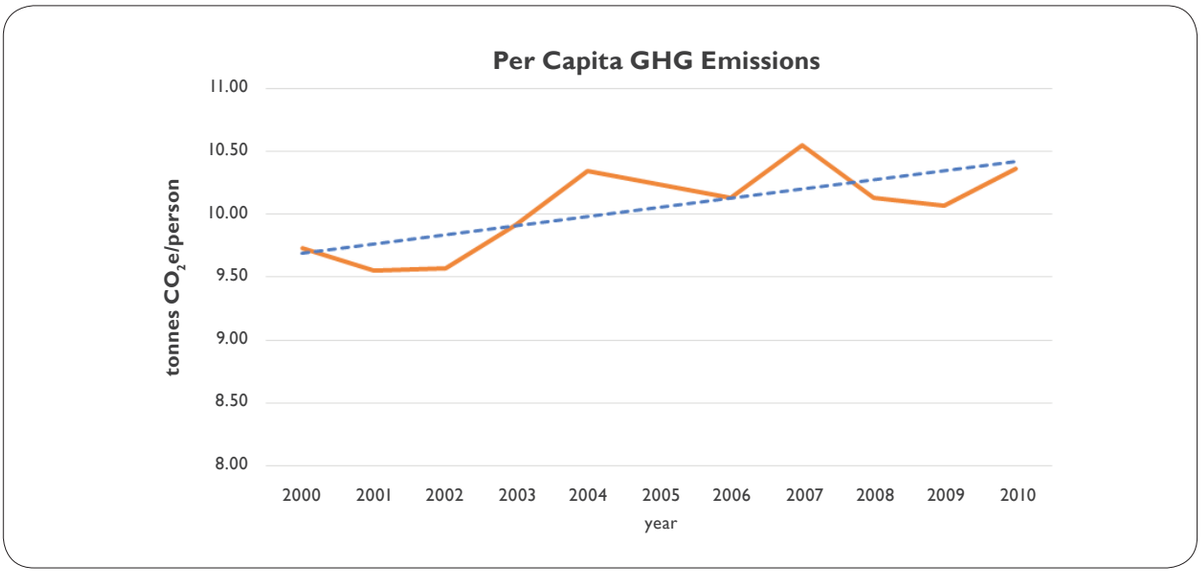


Figure 3: South Africa's per capita emissions for the period 2000–2010 *(population statistics from STATS-SA 2015a)*

2.2 Lower-carbon Consumption

The overall per capita emissions between 2000 and 2010 have remained fairly constant, averaging 10.1 tonnes CO_2e / person (**Figure 3**). South Africa's per capita consumption is among the highest compared to its developing country counterparts.

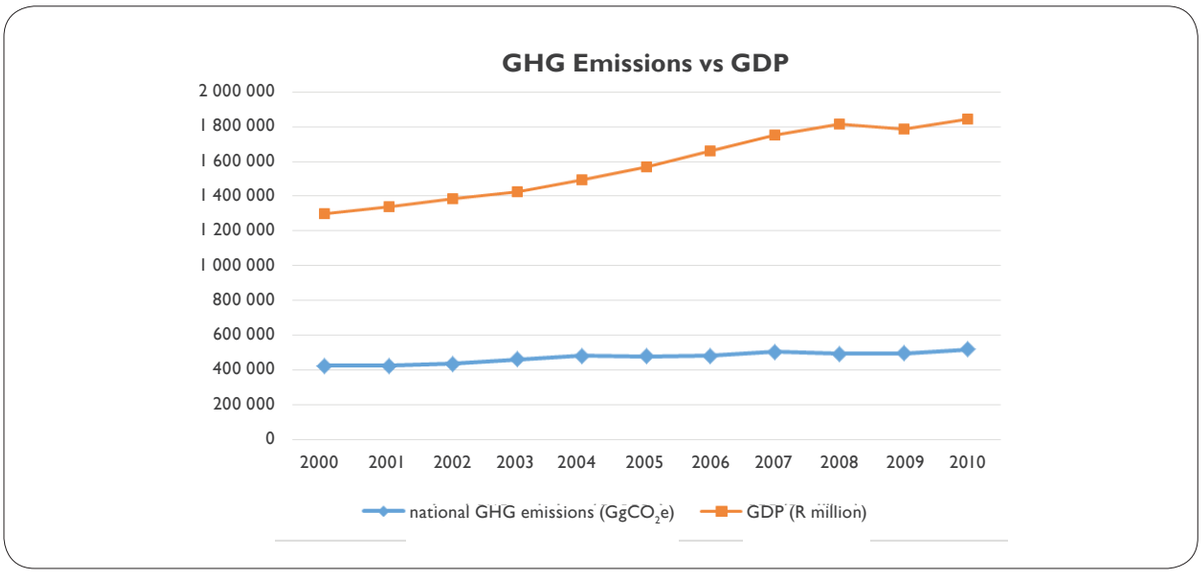


Figure 4: GHG emissions growth versus GDP growth (in constant 2005 prices) *(GDP data obtained from Stats-SA, 2010 and Stats-SA 2013)*

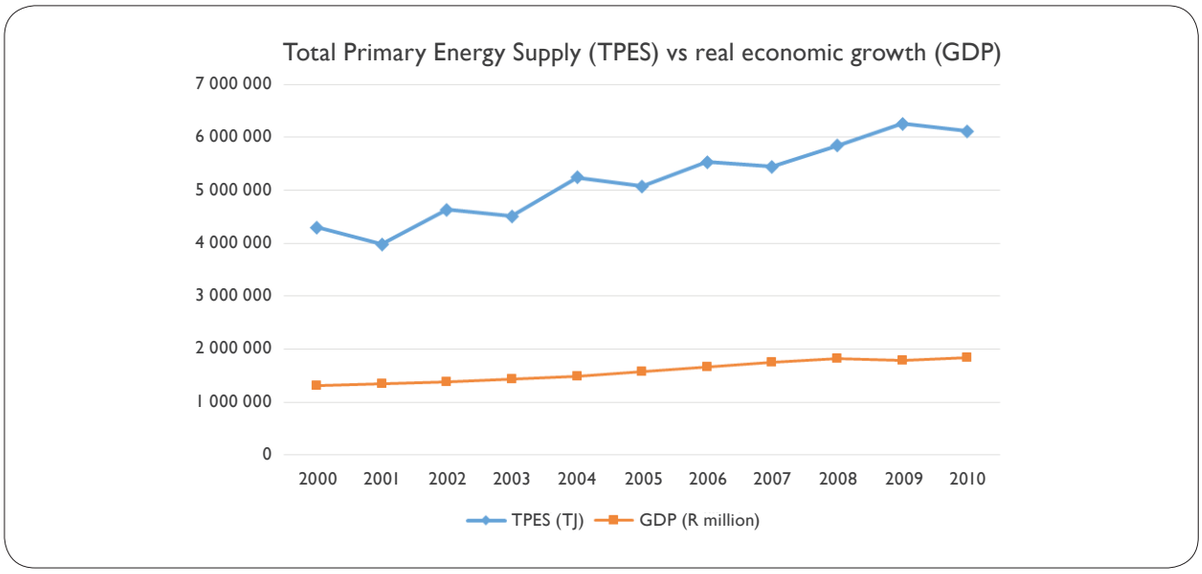


Figure 5: Growth in total primary energy supply vs. growth in GDP (at constant 2005 prices) *(energy data from DoE 2015)*

2.3 Lower-carbon Productivity

2.3.1 Carbon intensity of the economy

Figure 4 compares the growth in the country's GHG emissions with the country's economic growth, and shows that the economy has been growing marginally faster than the GHG emissions. This means that there has been a marginal decoupling of the economic growth from GHG emissions. This is due to a continuous decrease in the operations of energy-intensive sectors such as mining and heavy industries in the past 10 years, in favour of the less energy-intensive commercial sector. In 2000, it took the emission of 0.33 $GgCO_2e$ to generate R1 million of gross domestic product (GDP) and this value had been reduced to 0.28 $GgCO_2e$ by 2010 (see **Figure 7**).

2.3.2 Energy intensity of the economy

The energy intensity of the economy indicates the amount of energy that the country consumes to produce a single unit of GDP. **Figure 5** compares the growth of the country's total primary energy supply to economic growth for the period 2000–2010 at constant 2005 prices, and shows that the two have been growing at about the same rate, hence no significant decoupling of the two has occurred. On average, it took about 3.3 terajoules (TJs) of energy to produce R1 million of GDP (see **Figure 7**).

2.4 Lower-carbon Resourcing

2.4.1 Proportion of renewables and nuclear energy to total primary energy

Renewable energy and nuclear energy are the two energy sources in South Africa's energy systems that do not contribute to the national GHG inventory. An increase in their contribution to the energy system will result in a decrease in the carbon intensity of the national energy system. **Figure 6** presents the percentage contribution of renewables and nuclear and the absolute contribution of renewable energy, in terajoules, to the country's energy mix for the period 2000–2010.

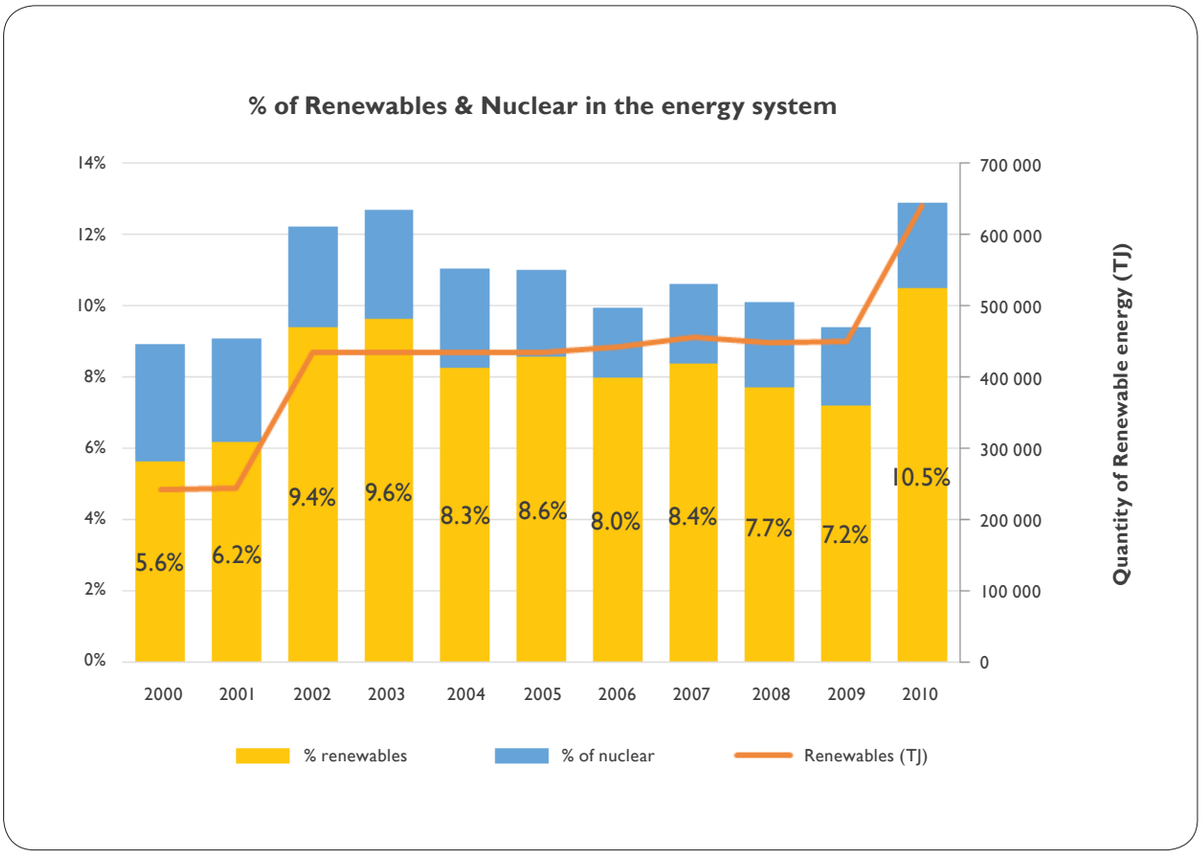


Figure 6: Percentage of renewables and nuclear in South Africa's energy system *(DoE 2015)*

The renewable energy contribution throughout this period has been from hydro-power, indigenous biomass usage in households, waste and solar (DoE 2015). The curve shows a significant increase in the absolute contribution of renewable energy from 244 800 TJ in 2001 to about 435 000 TJ in 2002 due to a doubling in the monitored consumption of biomass and waste (DoE 2015). A further significant increase in the consumption of renewables is observed in 2010, primarily due to an increase in solar installations and bio-energy. While the total primary energy supply (TPES) of the country kept increasing between 2002 and 2009, the graph shows that the consumption of renewables virtually remained constant during that period. There were no new installations of nuclear plants in the country between 2000 and 2010, hence no significant changes in the contribution of nuclear power to the electricity grid, apart from fluctuations resulting from downtime and availability of the existing Koeberg power plant.

2.4.2 Carbon intensity of the energy system

In addition to showing the carbon and energy intensities of the South African economy, **Figure 7** also presents the carbon intensity of the energy system. This is very closely aligned with the previous section on the proportion of renewables and nuclear in the energy system in that the higher the proportion of renewables and nuclear in the energy system, the lower will be the carbon intensity of the energy system. Thus, for the 2000–2010 period

the carbon intensity of the energy system has remained constant, owing to the fairly constant proportion of zero-carbon energy sources in the country's energy mix. An average of 0.08 $GgCO_2e$ was emitted into the atmosphere for every terajoule of primary energy consumed in the country.

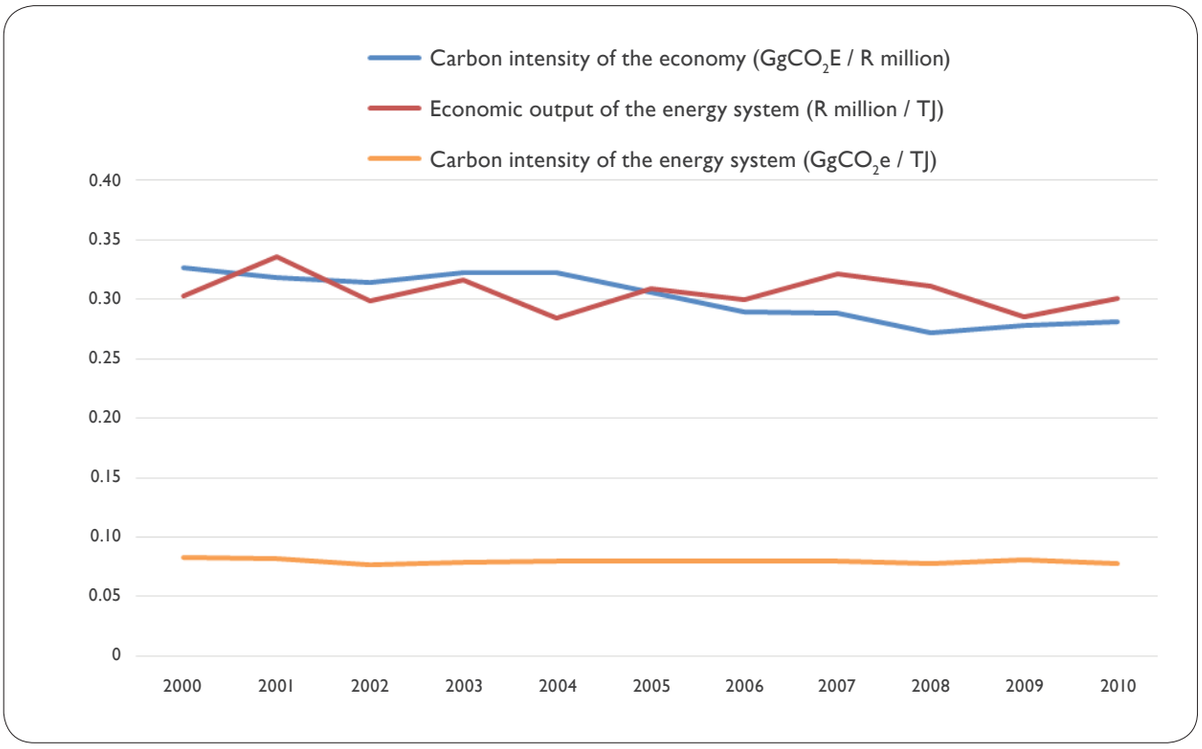


Figure 7: Summary of the key national intensity indicators

3. KEY NATIONAL AND INDUSTRY MITIGATION RESPONSE MEASURES

This section presents the results of the assessment of key mitigation response measures in the country, focusing on the core indicators identified in the Climate Change Response M&E system framework (See ***Theme B***):

- **Progress indicators:** Stages, phases, steps, and so on taken to implement the measure
- **Impact Indicators:** These include
  - impact on climate change mitigation (GHG emission reduction)
  - impact on job creation: number and type of jobs directly created
  - impact on other sustainable development indicators
- **Effectiveness indicators:** Cost effectiveness and job creation effectiveness.

While the primary focus is on tracking these indicators in the period 2000–2010 in line with the National GHG inventory, assessment for later years is also undertaken where information is available.

The assessment of the impact of mitigation response measures is presented in two parts, as follows:

- **Key national and industry mitigation actions:** The focus of this assessment is on high-impact and strategic response measures in which actual GHG emissions savings have been realised. This excludes programmes and projects which are yet to be implemented and/or to realise actual abatement of GHGs.
- **Low carbon development in provinces and cities:** This focuses on high-level mitigation programmes and projects initiated and implemented by provincial and local governments.

While there is a fine line between programmes coordinated centrally by a national department, organ of state or industry on the one hand, and those initiated and undertaken by provinces and cities themselves, this chapter recognises the need to have a dedicated focus on the overall contribution of provinces and cities to the country's transition towards a lower-carbon economy.

3.1 Mitigation Impact

Table 1 and **Figure 8** together summarise the results of the assessment of individual response measures coordinated centrally by national departments or by industry. Information about each individual response measure (or group) can be found in **Annex 1**. A summary of the emission and conversion factors used in the assessment can be found in **Annex 2**.

By 2010, a total of 330.1 $MtCO_2e$ emissions had been mitigated by key national and industry programmes in the country.

The results show that the achieved GHG reductions have generally been growing over time as more programmes that mitigate climate change are implemented. In 2011, 2012, 2013 and 2014 the annual emission reductions from these mitigation programmes was estimated at 71.0 $MtCO_2e$ / yr, 72.2 $MtCO_2e$ / yr, 73.7 $MtCO_2e$ / yr and 77.7 $MtCO_2e$ / yr respectively, bringing the total cumulative emission reductions since 2000 to 473.3 $MtCO_2e$ and 624.7 $MtCO_2e$ by 2012 and 2014 respectively. Information about each individual response measure can be found in **Annex 1**.

Energy efficiency has been the largest contributor to climate change mitigation in the country, accounting for 80%, 82% and 76% of emission reductions in 2010, 2012 and 2014 respectively, and 81% overall. Industrial fuel and feed switch programmes (excluding energy efficiency programmes) undertaken individually or through the Clean Development Mechanism (CDM) and the Green Fund contributed about 17% to the overall mitigation achieved.

Table 1: Summary of outcomes from key national and industry mitigation measures since 2000, up to 2010, up to 2012 and up to 2014 (Calculated from data supplied by the coordinators/implementers unless indicated otherwise)[1]

Theme	Response Measure	Coordinator / Implementer	Cumulative Emission Reductions ($MtCO_2e$)		
			up to 2010	up to 2012	up to 2014
Energy Efficiency	Energy Efficiency Target Monitoring System (EETMS) – overall EE achievements	Department of Energy (DoE)	268.1	386.6	505.1
	Integrated demand-side management (IDM)	Eskom	20.3	38.6	62.6
	Municipal Energy Efficiency Programme	DoE	0.02	0.2	0.5
	Industrial Energy Efficiency Improvement (IEE) Project	NCPC	0.1	0.4	1.3
	SASOL energy efficiency projects	SASOL	1.4	3.3	5.9
Electricity generation	Renewable Energy Independent Power Producers Programme (REIPPP)	DoE			3.3
	Eskom Open Cycle Gas Turbines (OCGT)	Eskom	0.3	0.4	1.2
	SASOL gas turbines	SASOL	0.9	3.2	6.2
Industrial Feed & Fuel Switch	SASOL coal-to-gas switch	SASOL	51.5	66.2	80.9
	Compressed Natural Gas (CNG) industry fuel switch	CNG holdings	0	0	0.008
Clean Development Mechanism (CDM)	All CDM, excluding energy efficiency projects (Data source: UNEP DTU partnership)	DoE	9.4	16.5	26.2
Green Fund	Green Fund	DBSA / DEA			0.02
Green Transport	DEA Green vehicles	DEA		0.0000004	0.000003
	Transnet Road-to-Rail Programme	Transnet		0.42	1.78
	Biofuels	Biofuel producers	0.0003	0.0007	0.0012
	CNG vehicle fuel switch (Data source: Industrial Development Corporation - IDC)	CNG holdings	0	0	0.003
Expanded Public Works Programmes	Working for Ecosystems, Land and Energy	DEA & SANEDI	Data unavailable	Data unavailable	0.04
		Total	330.1	473.3	624.7

1 EETMS data was only available until 2011. National energy efficiency was assumed to have remained constant from then onwards, potentially underestimating the real impact.

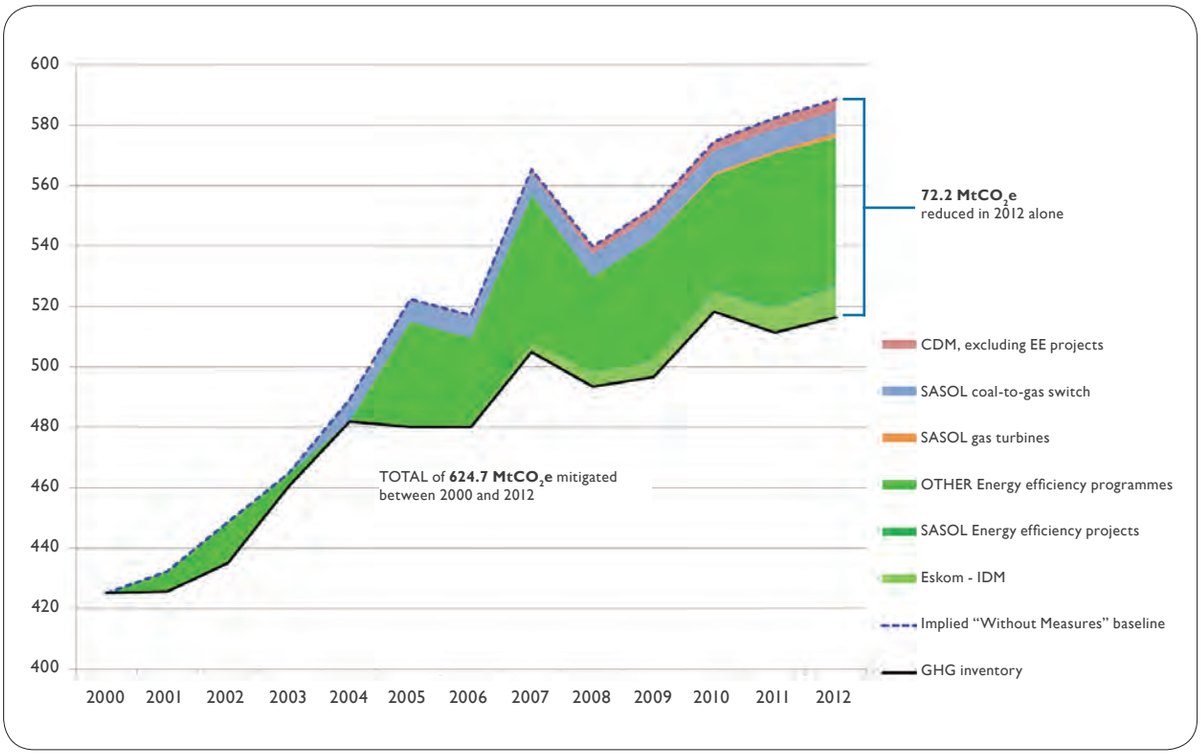


Figure 8: Annual emission reductions by key national and industry programmes and their impact on the National GHG Inventory
(2011 and 2012 GHG inventory numbers are taken from an unpublished draft GHG Inventory Report 2000–2012; data sources in Table 1 above)

3.2 Impact on Other Sustainable Development Indicators

The impact of these programmes on job-creation and other sustainable development indicators proved to be very difficult to assess as the associated information from the various databases or the programme implementers was not available. **Table 2** shows a summary of the estimated impacts of these mitigation programmes on job-creation and other sustainable development indicators where the information was available. A summary of the methods and impact factors used in the assessment of sustainable development indicators can be found in **Annex 2**.

By 2014, more than 40 500 jobs had been created through these major mitigation actions, with the Renewable Energy Independent Power Producer Procurement Programme (REIPPPP) and the Expanded Public Works Programmes (EPWPs) being the largest creators of jobs. The other key socio-economic indicators that were assessed for these projects were:

- Electricity saved, where a cumulative total of more than 64 400 GWh of electricity was saved by 2014.
- Local investment, where more than R212.8 billion rand came directly as a result of implementing these programmes.

In terms of environmental co-benefits, it is estimated that the emission of more than 770 000 tons of sulphur dioxide (SO_2), 400 000 tons of nitrogen oxides (NOx), 30 000 tons of particulate matter (PM) and 14 million tons of ash were avoided as a direct result of implementing these programmes. Additionally, more than 128 000 litres of water and 49 million tonnes of coal have been saved.

Table 2: Sustainable development benefits achieved through the key national and industry mitigation projects up to 2014. (N/E = not estimated; N/A = not applicable)
(Data sources similar to those for Table 1, summary of methods for estimating environmental impact can be found in Annex 2)

Mitigation Project	Socio-economic			Environmental					
	Number of Jobs	Department of Energy (DoE)	Local Investment Value (R million)	Avoided SO_2 (t)	Avoided NOx (t)	Avoided Particulate Matter (t)	Avoided Ash (kt)	Water Saved (Ml)	Coal Saved (kt)
Eskom IDM	N/E	62 586	6 664[2]	527 340	275 263	20 876	9 701	87 621	33 171
DoE Municipal Energy Efficiency programme	N/E	500	1 351	4 212	198	167	77	700	265
NCPC IEE Improvement Project	N/E	1 342	N/E	11 304	5 901	448	208	1 878	711
SASOL Energy Efficiency projects	N/E	N/E	N/E	N/E	N/E	N/E	N/E	N/E	N/E
REIPPPP	19 050	N/A	192 600	27 550	14 381	1 091	507	4 578	1 733
Eskom OCGT	N/E	N/A	N/E	63 888	31 977	1 876	1 213	10 958	4 149
Eskom OCGT	N/E	N/A	N/E	135 409	69 878	5 361	2 491	22 499	8 517
SASOL Coal-to-Gas Switch	N/E	N/A	12 600	N/E	N/E	N/E	N/E	N/E	N/E
CNG Vehicle & Industry Fuel Switch	30	N/A	N/E	N/E	N/E	N/E	N/E	N/E	N/E
All CDM, excluding energy efficiency projects	N/E	N/A	N/E	N/E	N/E	N/E	N/E	N/E	N/E
Green Fund	1 378	0.11	260	N/E	N/E	N/E	N/E	N/E	N/E
DEA Green Vehicles	0	N/A		0	0	0	0	0	0
Transnet Road-to-Rail Programme	N/E	N/A	N/E	N/E	N/E	N/E	N/E	N/E	N/E
Biofuels	N/E	N/A	N/E	N/E	N/E	N/E	N/E	N/E	N/E
EPWPs (Working for Ecosystems, Land and Energy)	20 070[3]	N/A	N/A	N/A	N/A	N/A	N/E	N/E	N/A
Total	**> 40 528**	**> 64 428**	**> 212 874**	**> 769 702**	**> 399 597**	**> 29 818**	**> 14 197**	**> 128 234**	**> 48 546**

2 This investment value is for the 2009–2014 period only. There was no information for earlier years.

3 This is the number of jobs created in the 2011–2014 period only for the three EPWP programmes. Information for earlier years was not available.

4. LOW CARBON DEVELOPMENT IN PROVINCES AND CITIES

This section presents the big picture on how provinces and cities are contributing to the country's transition to a lower-carbon economy. Over the years, a rich depository of energy data – charting consumption trends in major cities since 2003 – has been developed through the South African Urban Energy Network. However, there is no comprehensive, reliable database tracking provincial and municipal data at individual response or project level. Hence it was not possible to assess the mitigation impact of individual response measures implemented by provinces or cities, apart from those that have already been included in the preceding chapter under the Clean Development Mechanism (CDM), the Department of Energy's (DoE's) Municipal Energy Efficiency and Demand Side Management programme (EEDSM) and the REIPPPP.

The carbon*n* Climate Registry (cCR) is an existing global online database for local government and provincial climate change mitigation and adaptation information, including response measures. It has been identified in the National Climate Change Response M&E System Framework as a useful existing platform which should support data sharing of information on response measures by South African provincial and local governments with the national M&E system (see ***Theme B***). The ultimate aim is a seamless integration between the two systems enabling single reporting.

This section has been compiled using the following methodology:

- **Primary research**
  - Cross-departmental data-collection workshops held with government officers of Gauteng and KwaZulu-Natal Provinces, Ekurhuleni Metro, Msunduzi, Mogale City and Mbombela Local Municipalities in August–September 2015.
  - Questions were distributed to metropolitan cities, provincial governments and a number of secondary cities. Only six metros, four provinces and two municipalities responded.

Turbine assembly at Jeffreys Bay Wind Farm

- **Secondary research**[4]
  - The existing data profiles of users of the cCR (2016) were used (six metros and four municipalities). Quality data reporting to the cCR in the metros has been driven by the Earth Hour City Challenge (EHCC) – an annual competition run by the World Wildlife Fund and the International Council for Local Environmental Initiatives (ICLEI).
  - Existing studies and reports were used to combine existing knowledge. (See SACN & SEA publications in reference section).
  - The existing entries to the National Climate Change Response Database (NCCRD) were included in the analysis (NCCRD, 2015).
  - The aggregate outcomes of the Energy Efficiency Demand Side Management (EEDSM) programme were included, using data received from the DoE.

Table 3 below summarises the data-gathering method used to compile this section of the report.

Table 3: Summary of approach to data gathering for this report

Institutions		Comprehensive information reported in the cCR	Partial information reported in the cCR	Data received specifically for this report	Minimal or no data used in this chapter
Provinces	Western Cape				
	Gauteng		08/2015		
	KwaZulu-Natal				
	Eastern Cape				
	Northern Cape				
	Free State				
	North West				
	Mpumalanga				
	Limpopo				
Metros	eThekwini	2012?			
	Nelson Mandela Bay	2013			
	City of Cape Town	2012?			
	Buffalo City		2013		
	Mangaung				

4 City of Cape Town, City of Tshwane, City of Johannesburg, Ekurhuleni, George and KwaDukuza updated their profiles on 13 Nov 2015 for the 2015–16 EHCC, not in time, however, to include these updates in this section's analysis

Table 3 continued...

Institutions		Comprehensive information reported in the cCR	Partial information reported in the cCR	Data received specifically for this report	Minimal or no data used in this chapter
Metros	Johannesburg	2013			
	City of Tshwane	2013			
	Ekurhuleni	08/2015			
Secondary & smaller cities	Msunduzi		08/2015		
	Mogale City		08/2015		
	Polokwane				
	Mbombela		08/2015		
	Rustenburg				
	Kimberley		2013		
	KwaDukuza	2014			
	uMhlathuze		2014		
	Steve Tshwete		2014		
	George				
	Hessequa				
	Mossel Bay				
	Overstrand				
	Drakenstein				
	Knysna				
	Saldanha Bay				
	Swartland				
	Bergrivier				
	Langeberg				
	Bitou				
	Theewaterskloof				
	Oudtshoorn				
	Kleinmond				
	Wellington				
	Cape Agulhas				
	Stellenbosch				
	Vredendal				

4.1 What can be Termed "Low Carbon Action" in Provincial and Local Governments?

For purposes of this section, low carbon actions are thematically categorised as follows, based on national and international good practice:[5]

- **Energy efficiency**, especially in municipal infrastructure such as street lights, traffic lights, buildings, water infrastructure and municipal fleet.
- **Renewable energy (supply)**, namely solar, hydro, wind and waste to energy technologies.
- **Sustainable transport**, including fuel switching, public and non-motorised transport.
- **Efficient spatial planning**, including policies and strategies to promote green buildings, sustainable human settlements, densification and mixed use developments.
- **Waste management**, where municipalities have reported waste management responses (such as waste avoidance through recycling or composting), this is included.[6]
- **Green Procurement**, namely modifying the purchasing of goods and services to include resource efficiency criteria; energy is often one such criteria.

A number of other municipal actions have an impact (sometimes indirect) on carbon emissions, for example, water efficiency measures which also reduce energy consumption through reduced pumping, or provision of good gardens. Often though, these are not reported by municipalities as "low carbon", and have a relatively smaller quantifiable impact, though they are no less important to sustainable development.

The list above highlights the cross-cutting nature of low carbon actions. Over the past 15 years, the understanding and awareness of climate change in sub-national government has grown enormously. Low carbon development issues are increasingly understood as being cross-cutting: affecting social development, jobs and economic opportunities. Despite this, "climate change response" is often narrowly deemed to be the responsibility of the environmental management unit.

4.2 Provincial Government: An Increasingly Important Role Player

In total, 76 provincial government actions have been captured, dating from 2005 to 2015. Only five of these (from Gauteng Province) have been reported to the cCR. This data covers four Provinces (Eastern Cape, Western Cape, Gauteng and KZN). **Figure 9** shows that provincial government is largely:

- commissioning and conducting research to build the evidence base for green economic development
- developing overarching strategies
- engaging stakeholders through education and awareness initiatives

In terms of thematic areas, a large number of provincial government responses are "cross-cutting" (49%), as **Figure 10** shows. These include strategies covering various aspects of sustainable energy, education and awareness initiatives that cover climate change more broadly. The focus on renewable energy is largely explained through the existence of the Renewable Energy Independent Power Producers Programme.

5 Agriculture, forestry and other land use (AFOLU), an important category, is not explicitly considered here. Many municipalities cover large rural areas and the practices they encourage, and the way they interact with provincial agricultural / rural development departments, can have an impact on emissions in this sector. Further analysis is required to ascertain the extent of response measures in this category.

6 As not all reporting entities may have considered waste recycling initiatives as strictly "climate mitigation" there may be an under-representation of waste management activities.

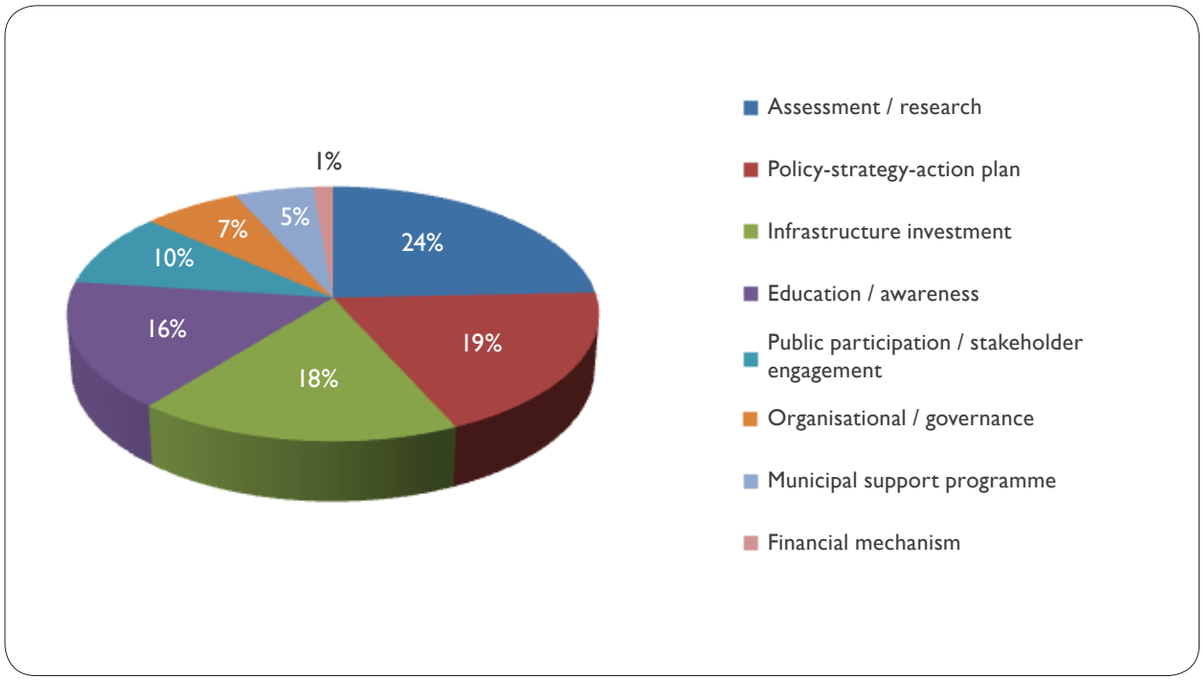


Figure 9: Provincial response measures by type

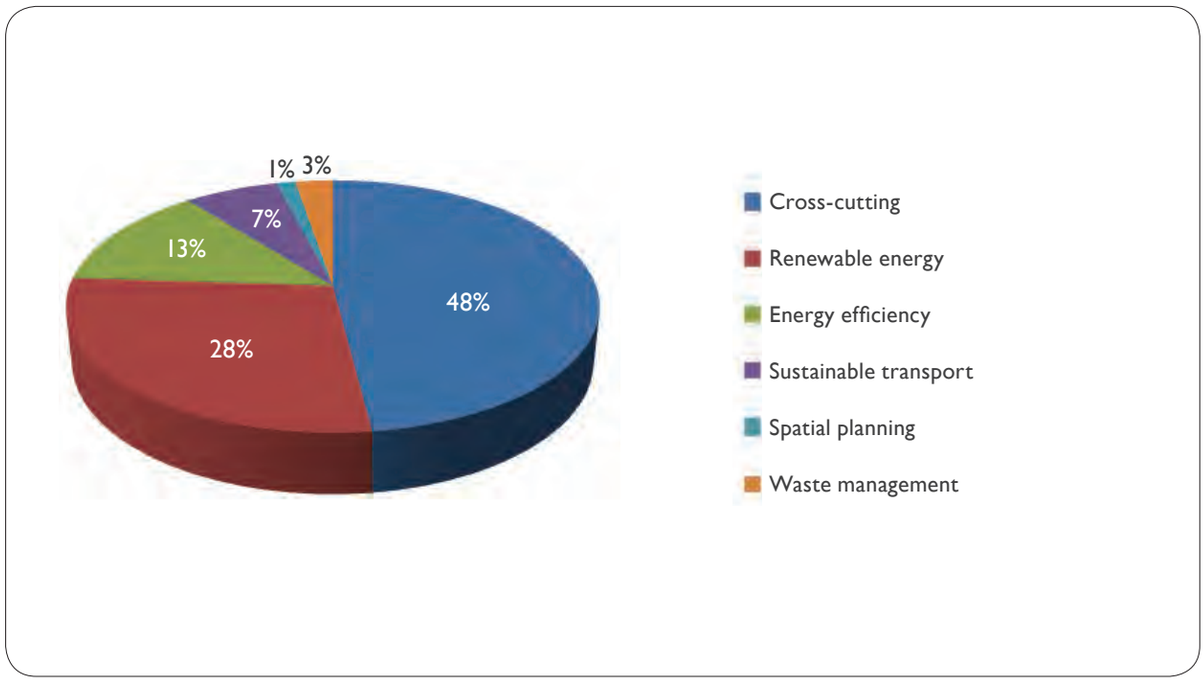


Figure 10: Provincial response measures by theme

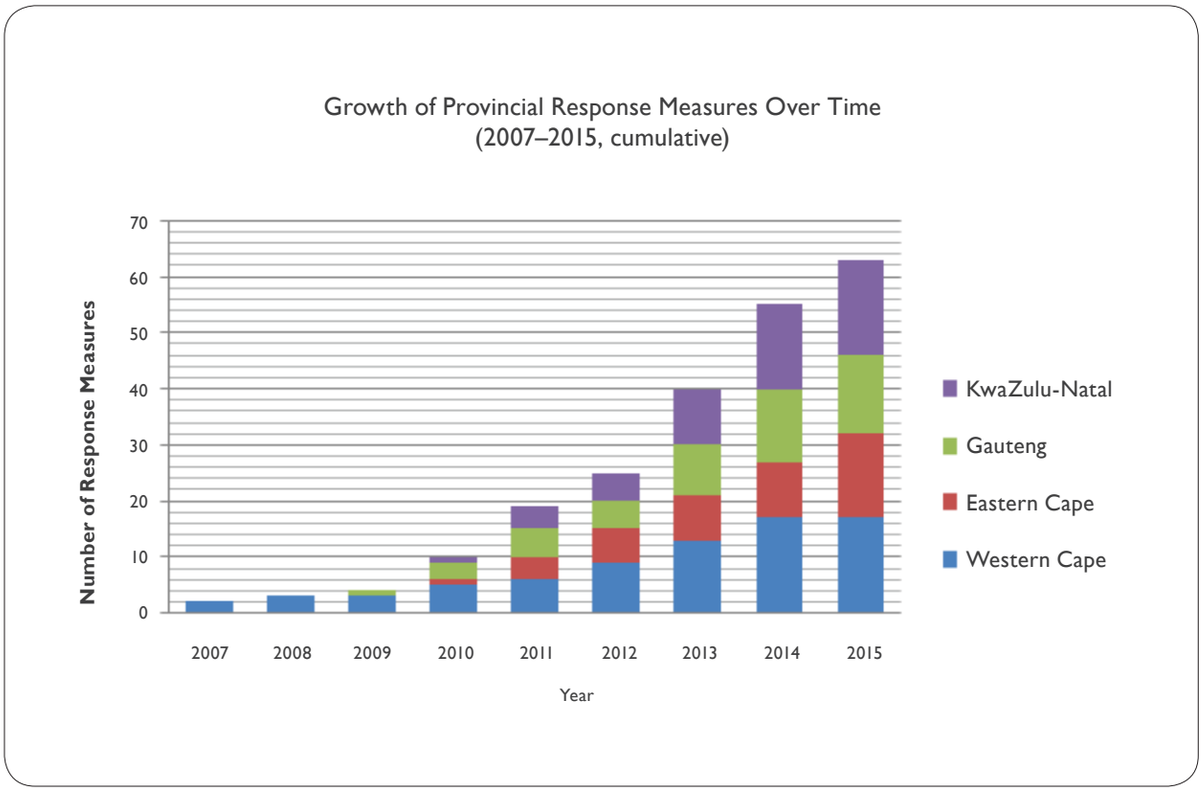


Figure 11: Growth of provincial response measures over time, by province (2007–2015)

The data available suggests a steady increase in the number of responses implemented by provincial governments since 2010 (**Figure 11**). A number of new overarching climate change and energy-related strategies were developed in the period 2010–2012 which may explain the emergence of a large number of responses since then.

In most provinces, the low-carbon response is driven from the economic development and tourism department. This relates to a second major driver cited by the provinces: the potential economic spin-offs of promoting lower-carbon development, mainly in the form of renewable energy and the waste economy.

4.3 Metros: A Long History of Action

The eight metros[7] of South Africa have the longest history of acting to promote lower-carbon development, with certain actions reported as far back as 2003. They represent the biggest concentrations of economic activity and energy consumption in the country, and have more control over critical service delivery functions which affect carbon emissions.

4.3.1 What does the data show?

In total 144 individual climate change responses by the metros have been captured. In the past 15 years,

7 The data captured covers all metros except Mangaung Metropolitan Municipality.

the majority of metros have undergone a journey to institutionalise a low carbon approach to their service delivery. All metros have developed strategic documents that guide their low carbon development direction.

The exponential increase in climate change activity by metropolitan cities is demonstrated by **Figure 12**, which shows the cumulative growth in response measures over time.

Figure 13 and **Figure 14** present the response measures of metropolitan cities, disaggregated by type and by theme respectively. Fifty-two per cent of the response measures are technical or infrastructural investments. While a large number of these have been pilot projects, or relatively small in scale, they represent a large body of learning and experience driven by a relatively small but growing group of champions.

Only one metro has used local by-law setting powers to promote low-carbon development (Tshwane's green building by-law), rather preferring "soft" approaches such as guidelines, strategies and education and awareness initiatives.

Figure 14 shows that **energy efficiency** responses have been the most numerous, demonstrating the strong role municipalities can play in managing energy demand. Twenty-six of the 38 energy efficiency responses were in municipal-owned buildings, with 10 in street and traffic

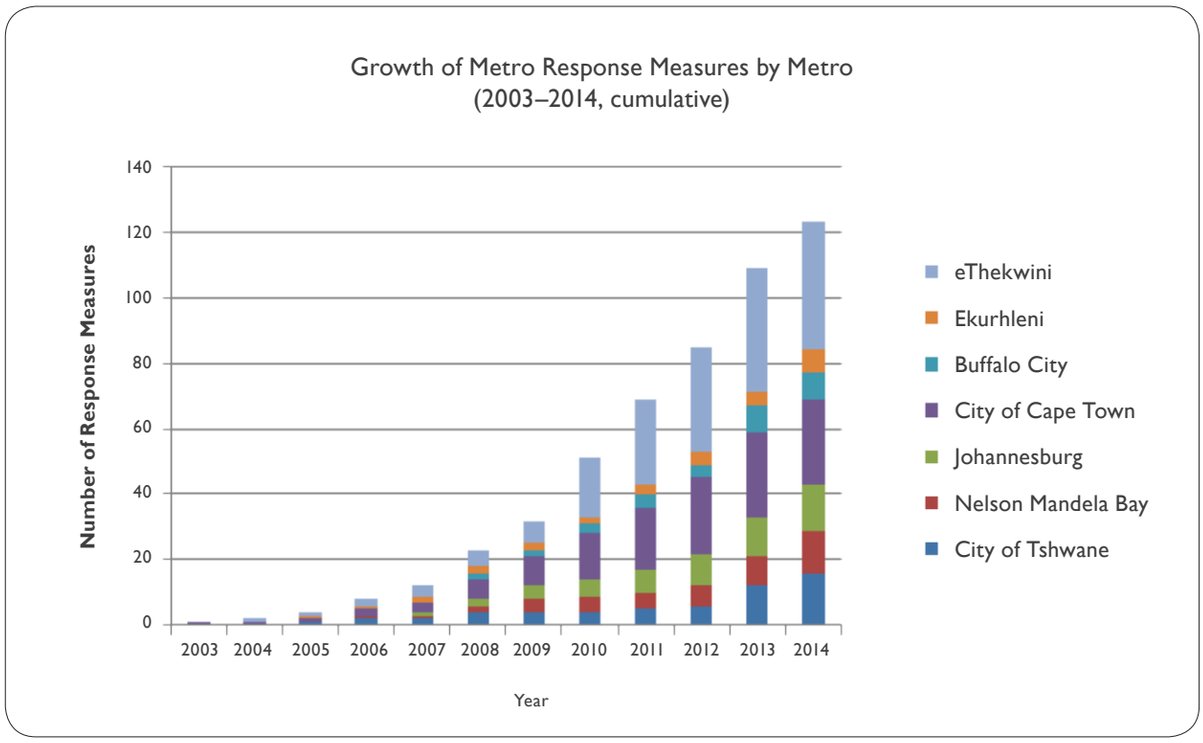


Figure 12: Growth of metro response measures from 2003 to 2014[8]

8 Some metros report aggregate responses in one individual data response (for example grouping individual building energy retrofits into an entire municipal retrofitting programme). In some cases, for example Ekurhuleni, the data reflects a lack of reporting rather than lack of action.

light retrofits. Four metros have indicated that they have achieved a 100% penetration rate of LED traffic light retrofits (SACN 2014). In a typical metro, municipal owned infrastructure is responsible for approximately 2% of GHG emissions – so while these projects are making a relatively small dent in overall city emissions, they are important to demonstrate leadership, and to make the internal financial case for further action. The leading cities have begun to implement community support programmes which either roll out (lower-income), or encourage / incentivise (mid-high income) energy efficiency among local residents – which has the potential for much wider systemic change.

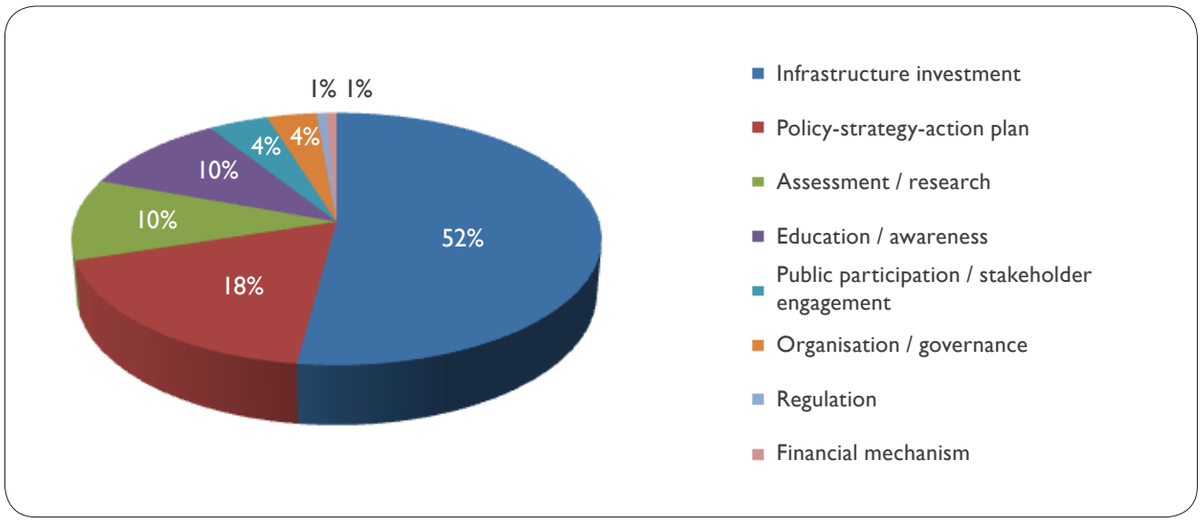


Figure 13: Metro response measures by type

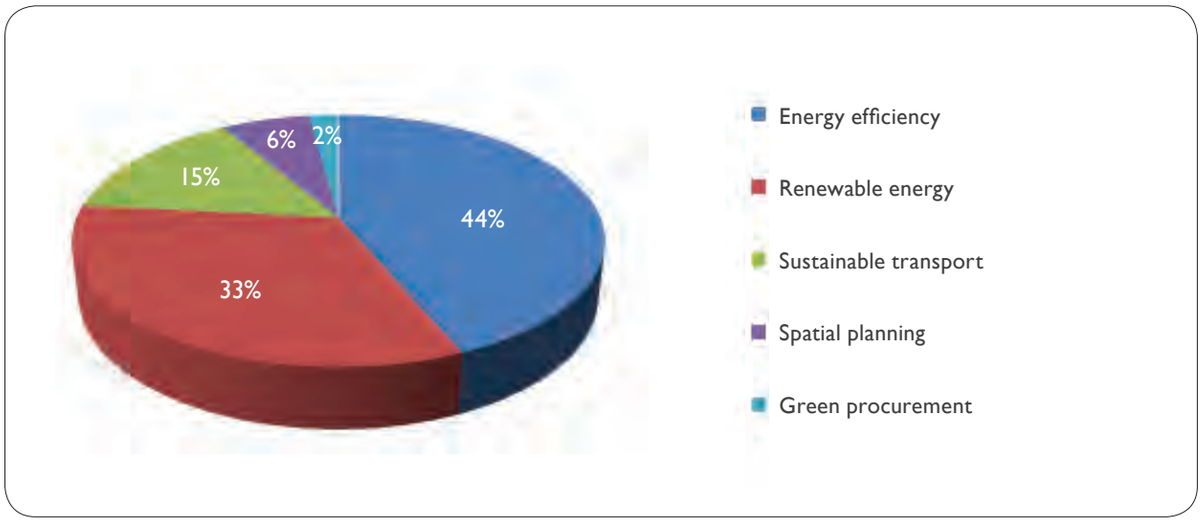


Figure 14: Metro response measures by theme

The South African Cities Network (SACN, 2014) commissioned research to assess the energy efficiency potential within the municipal operations of its nine member cities. While data availability was a limiting factor, this report suggested that in municipal fleets, buildings, water supply / waste water treatment works and street lighting, there was an untapped potential for R10 million in savings per metro per year.

4.3.2 Overarching trends in metropolitan cities (2004–2011)

This section presents overall energy and GHG emission trends for metropolitan cities for the period 2004–2011, based on Sustainable Energy Africa's (SEA) 2015 State of Energy in South African Cities report.

1. Overall energy consumption

From 2004 to 2011, the population in metros increased by 2.9%, and their economies by 4.2%, translating to an increase in their overall energy consumption. The increase in energy consumption has also been due partly to national government's impressive electrification programme which has led to the percentage of households with electricity increasing from about 36% in 1994 to about 87% in 2012 (SEA 2015). **Figure 15** shows energy consumption trends for all metros.

While there has been an increase in absolute energy consumption by Metropolitan cities, results, however,

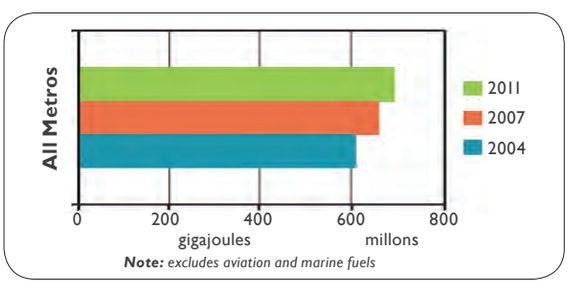


Figure 15: Metro's overall energy consumption (excluding aviation and marine fuels) *(SEA 2015 26)*

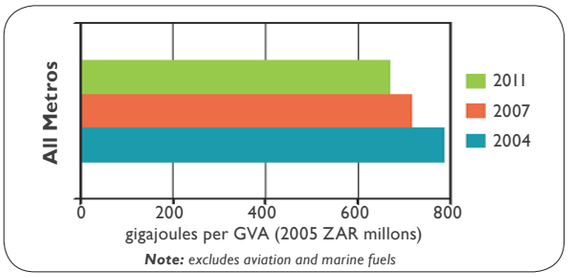


Figure 16: Energy consumption per economic output for all metros *(SEA 2015 29)*

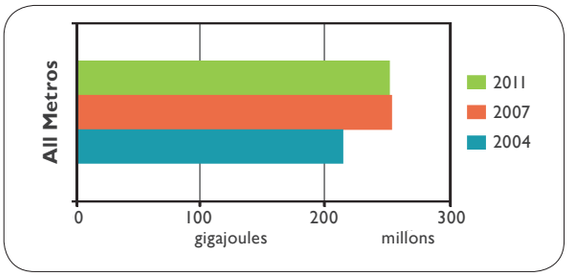


Figure 17: Metros' electricity consumption over time *(SEA 2015 27)*

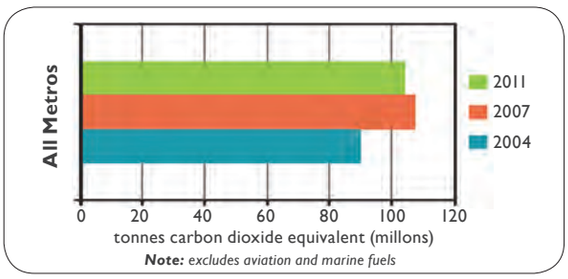


Figure 18: Energy-related GHG emissions in metropolitan municipalities *(SEA 2015 28)*

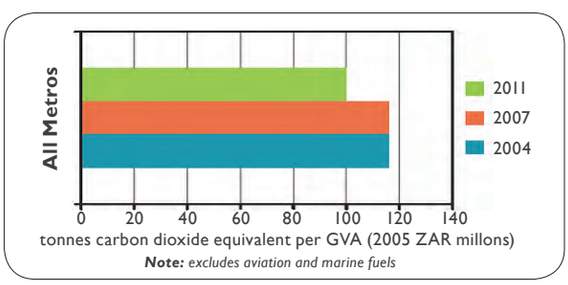


Figure 19: Energy related emissions per economic output for metros *(SEA 2015 29)*

show that the efficiency of using this energy has been improving significantly over time. **Figure 16** shows that the 1.8% annual increase in energy consumption between 2004 and 2011 has led to a 4.2% increase in economic growth. (SEA 2015). This suggests a slight overall decoupling of economic growth from energy consumption in metropolitan cities.

2. **Electricity consumption**

Despite energy consumption increasing, **Figure 17** shows a slight electricity decrease in metros from 2007 to 2011, this occurring despite an increase in electrification during this period. This is likely a result of a combination of behaviour change and efficiency (namely technological interventions), in itself most likely driven by increasing electricity prices.

3. **Energy-related GHG emissions**

While there has been an increase in both economic growth and overall energy consumption in metropolitan cities in the period 2004–2011, **Figure 18** and **Figure 19** below show that energy-related GHG emissions have decreased in absolute terms and per economic output. This represents a relative decoupling of GHG emissions from economic growth, consistent with the decreasing carbon intensity of the South African economy presented by **Figure 4** and **Figure 7**.

4.4 Secondary Cities: The High-Consuming Cities of Tomorrow

According to the South African Cities' Network (SACN, 2013) there are 22 secondary municipalities in the country, of which 11 are included in this analysis, along with 19 smaller municipalities, located largely in the Western Cape, which are also included due to the provinces' energy projects database.

There were 97 response measures reported by 30 secondary and smaller municipalities. The pattern of responses (**Figure 20**) is similar to that of the metros.

More than half of reported actions are predominantly infrastructure investments, ranging from bus rapid transit (BRT) roll-outs funded by national government, to smaller scale maintenance, recycling and energy efficiency projects.

The penetration of renewable energy initiatives is much smaller than in the metros. Only 12 of the 95 responses were related to renewable energy in the fields of solar photovoltaic (PV) and waste to energy.

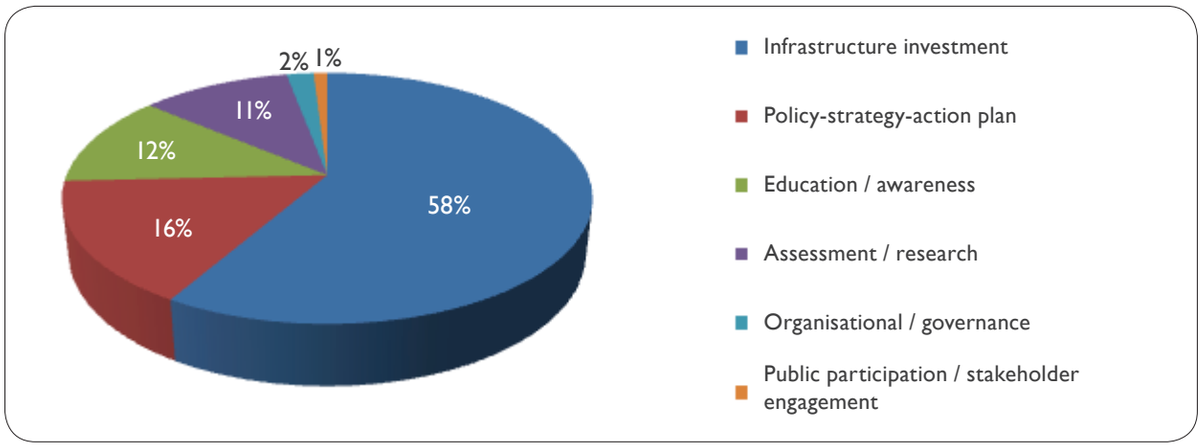


Figure 20: Secondary municipalities' response measures by type

5. CONCLUSIONS, KEY MESSAGES AND RECOMMENDATIONS

While there is an overarching challenge of data availability and/or data quality in tracking South African's transition to a lower-carbon economy, there are a number of key conclusions that can be clearly drawn from this chapter:

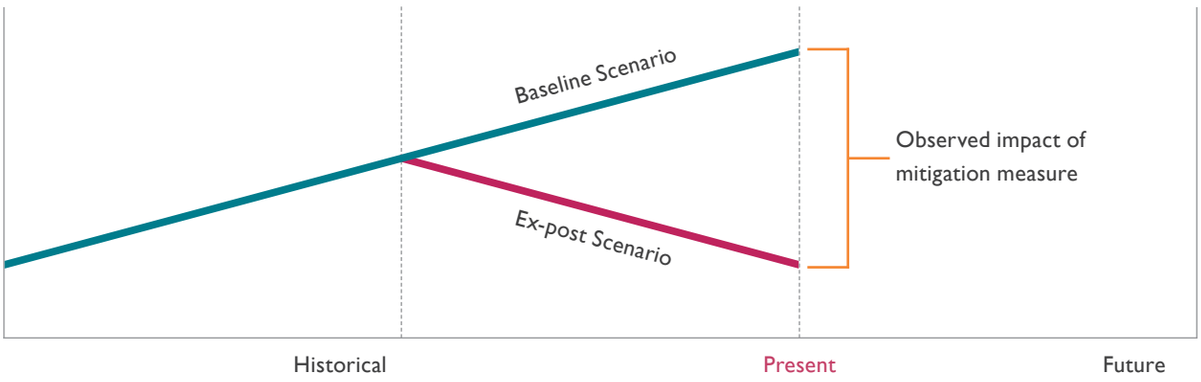
- In 2010, South Africa's greenhouse gas emissions were within the national goal of the Peak, Plateau and Decline (PPD) trajectory.
- The implied "carbon budget" between the country's 2010 emissions levels of 518 $MtCO_2e$ and the maximum emission levels of 614 $MtCO_2e$ presented in the country's Intended Nationally Determined Contribution under the UNFCCC in 2025 is about 96 $MtCO_2e$.
- There are many programmes and projects with mitigation impact being implemented in the country, with the bulk of these being energy efficiency programmes and projects.
- By 2014, a cumulative total of 624.7 $MtCO_2e$ was mitigated though a number of major national-level and industry programmes, with about 78 $MtCO_2e$ being reduced in 2014 alone.
- At least 40 000 jobs created by 2014 can be termed green jobs, having been created by programmes that have significant climate change mitigation impact.
- More than 15 million tonnes of local air pollutants were avoided through implementation of these key mitigation programmes by 2014.
- Provincial and local governments have been playing very important and significant roles in South Africa's transition to a lower-carbon economy, particularly driving and/or supporting implementation of programmes on energy efficiency, renewable energy (supply), sustainable transport, efficient spatial planning, waste management and green procurement.
- Overall energy-related GHG emissions from metropolitan cities have decreased between 2004 and 2011, both in absolute terms and per economic output. This is despite an increase in overall energy consumption in those cities, which shows that metropolitan cities are becoming more energy efficient overall!
- Availability of data remains the biggest barrier to effective tracking and assessment of South Africa's transition to a lower-carbon economy. There is a dire need for key climate change response actors, including government departments (national, provincial and local), industry and NGOs to collect, measure and monitor primary output data on climate-related projects and programmes more effectively and systematically.
- South Africa's National Climate Change Response M&E system, and its associated annual climate change report presents an opportunity for owners and implementers of climate-related programmes not only to showcase their work, but also to learn from the lessons generated by others in the past.

ANNEXES

ANNEXE I: INDIVIDUAL OR GROUPS OF RESPONSE MEASURES

This Annexe summarises each individual or group of mitigation response measures covered and assessed in this report. The general approach used to assess the impact of all the mitigation programmes or projects in this report involves determining the difference in the emissions released under a "baseline scenario" (in the absence of the mitigation measure) and under an "ex-post scenario" (when the mitigation measure is implemented).

A constant emission factor of 1.0005 $kgCO_2e/kWh$ for South Africa's electricity grid, accounting for transmission and distribution losses, has been used in the analysis (Letete et al. 2009; Zhou et al. 2009). Standard Intergovernmental Panel on Climate Change (IPCC) emission factors have been used everywhere else (IPCC 2015). See Appendix 2 for impact factors used for assessing sustainable development co-benefits.



Ex-post Assessment

GHG emissions reduced = baseline scenario emissions - measure scenario emissions

Construction of the Tshwane Food and Energy Centre, Tshwane

1 ENERGY EFFICIENCY

The Department of Energy has begun monitoring on an annual basis the total outcome of all energy efficiency measures in the country through the Energy Efficiency Target Monitoring System (EETMS). The first EETMS report was released in 2014 covering the period 2001–2011. This report showed that a total of 1 970 Peta-Joules of energy was saved in the industrial, commercial, public services and residential sectors during the entire period (DoE 2014). The report, however, does not disaggregate the savings by type of energy. If the savings are assumed to be proportional to the types of energy used in the sectors covered, according to the national energy balances in those years, these energy savings correspond to GHG emission savings or mitigation of about 327 $MtCO_2e$. **Figure 21** presents the annualised GHG emission savings from all energy efficiency measures during that period, showing an average increase of 5 $MtCO_2e$ in GHG emissions reduced per year.

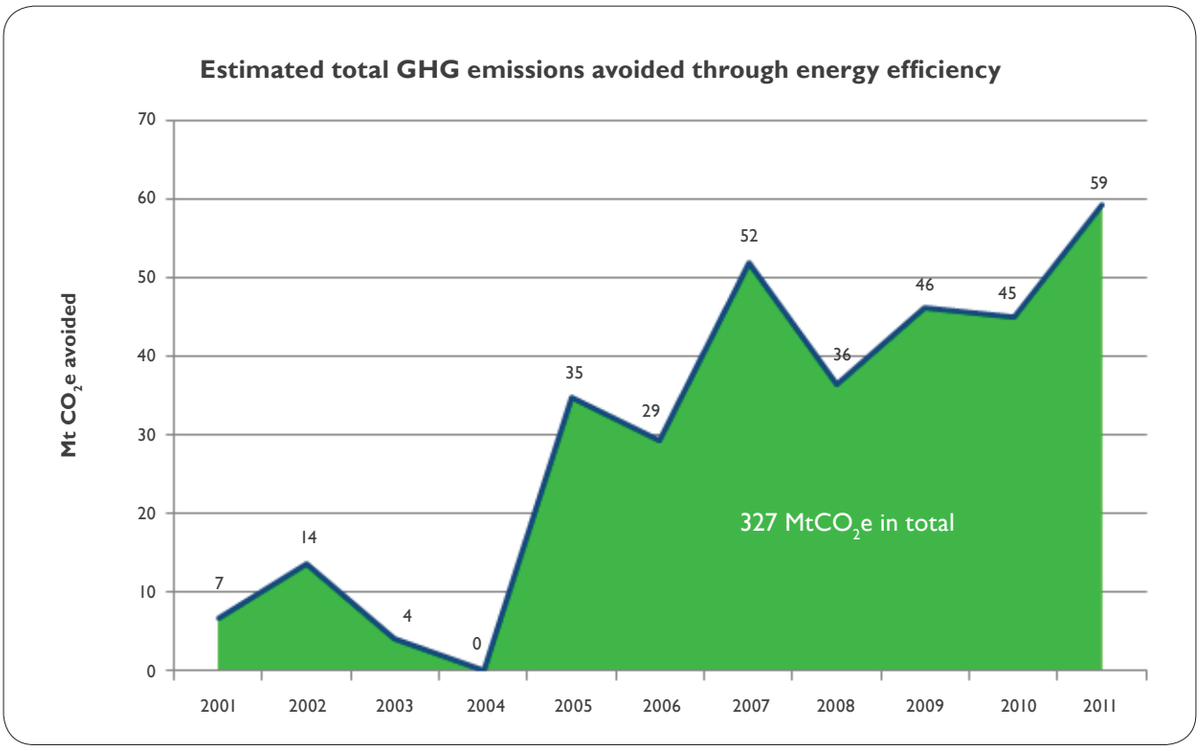
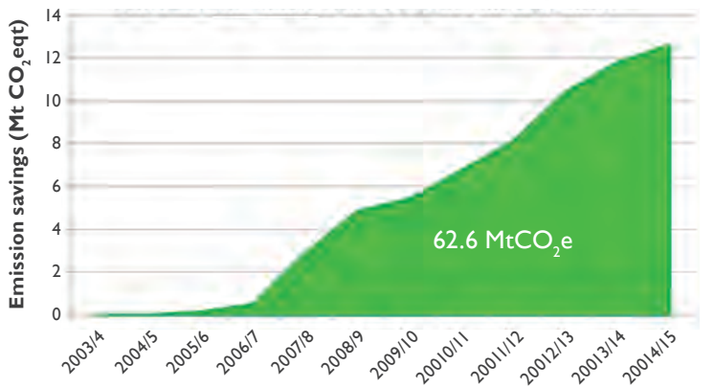


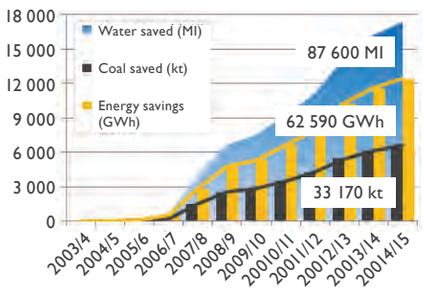
Figure 21: Annual GHG emission savings from all energy efficiency measures in the country for the period 2001–2011 *(Data source: DoE 2014)*

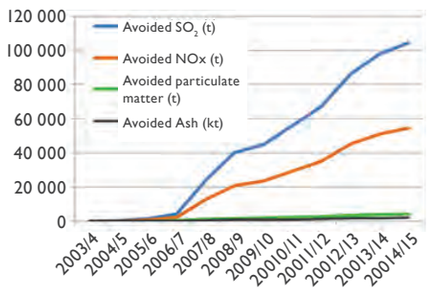
The sub-sections below present the major energy efficiency programmes which contributed to this overall outcome.

1.1 Eskom Integrated Demand Management Programme

General details of the response measure	
Name of response measure	The Eskom Integrated Demand Management (IDM) Programme
Project description / snapshot	The programme includes a number of rebate incentives for the residential, commercial and industrial sectors. Eskom promotes energy efficiency projects implemented for or by various institutions, and then purchases a percentage of the energy savings they generate upfront thus securing a demand reduction over a period of time. This includes rebates for installation of solar water heaters in the residential sector.
Primary intended outcome	Reducing demand for electricity throughout the day, but specifically during peak hours.
Progress	
Implementation plan	The programme was initiated in 2004, but was put on hold until further notice in 2013. More than 5 000 projects were registered under the programme during this period.
Climate change mitigation impact of the programme	**GHG emission savings from the Eskom IDM programme**  A total of 62.6 MtCO_2e GHG emissions were saved through this programme from 2003 to 2015. The projects achieved maximum annual GHG emissions savings of 12.4 MtCO_2e in 2014/15.
Direct job creation	The response measure created a number of jobs for technicians to install geysers, compact fluorescent lamp (CFL) lights and other energy efficient technologies. Information on the actual number of jobs created was not available.
Source of Data used	Eskom IDM department

Other sustainable development benefits





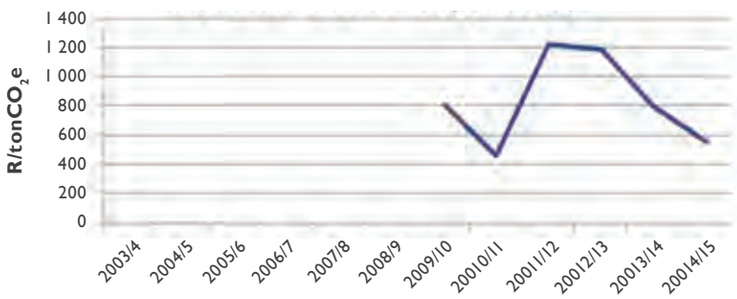
Since its initiation the programme has saved a total of 87 600 million litres of water, 62 590 gigawatt hours (62.6 terawatt hours) of electricity and 33 170 kilotonnes (33.2 million tonnes) of coal. It has also avoided the emission of 9.7 megatonnes of ash, 20.8 kilotonnes of particulate matter, 275 kilotonnes of NOx and 527 kilotonnes of SO_2.

Total acummulative demand savings reached, 4 125 MW in 2014/15.

Programme cost

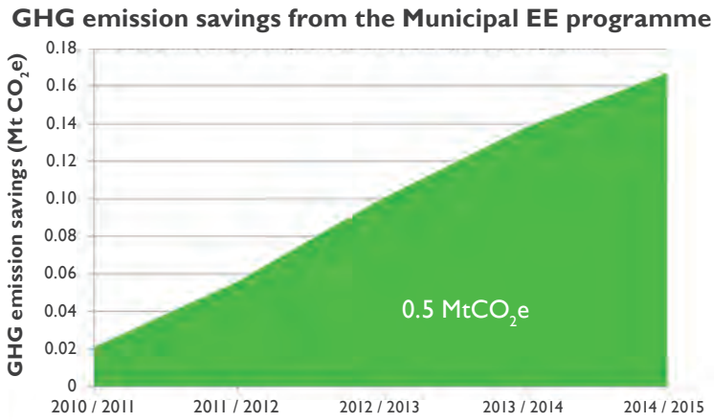
The cost of the programme ranges between R440 million in 2014/15 and R2 560million in 2013/14. The figure below shows the implied GHG abatement cost in R/ton CO_2e.

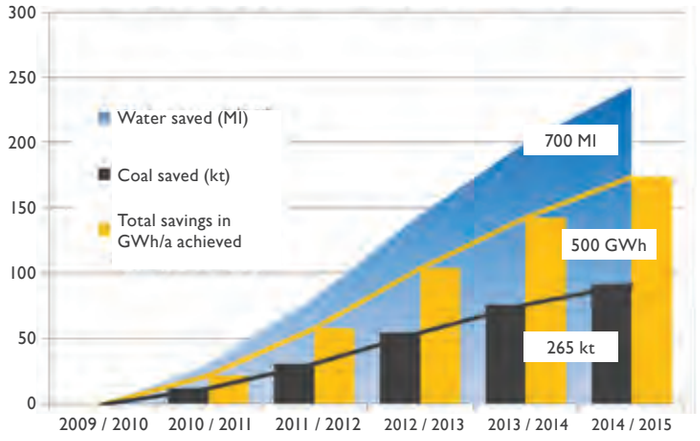
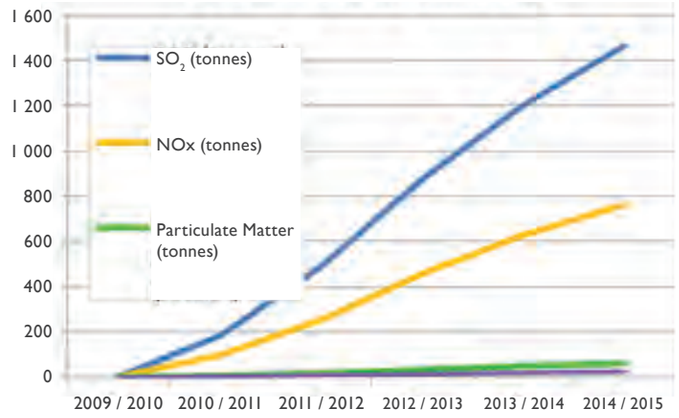
Implied cost-effectiveness (R/tonCO_2e)



The implied GHG abatement cost per ton of CO_2e for this programme ranges between R457 in 2011 / 12 and R1 223 in 2012/13.

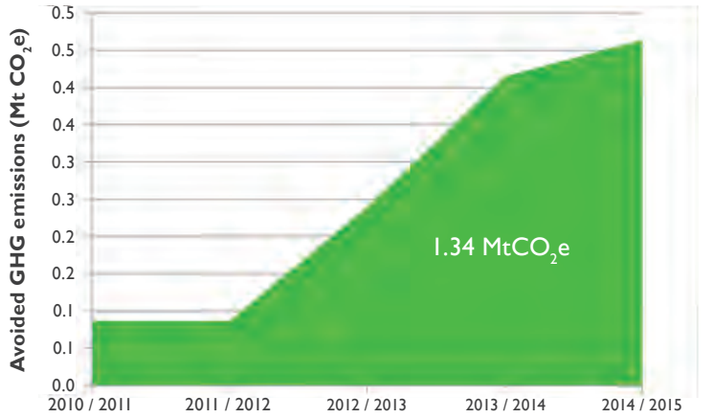
1.2 DoE Municipal Energy Efficiency and Demand Side Management Programme

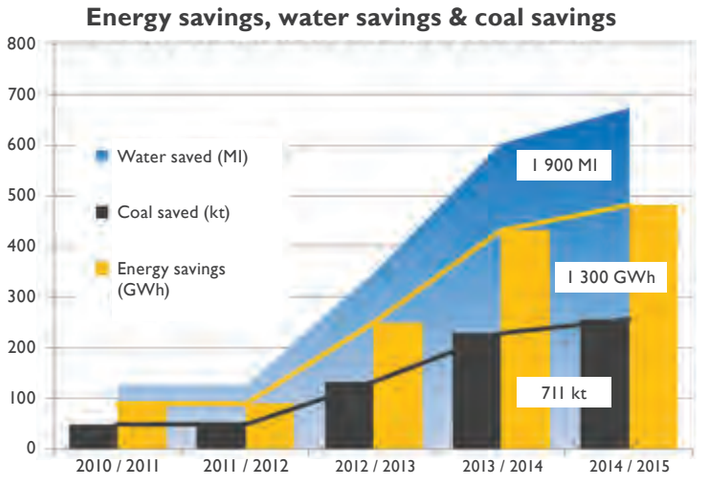
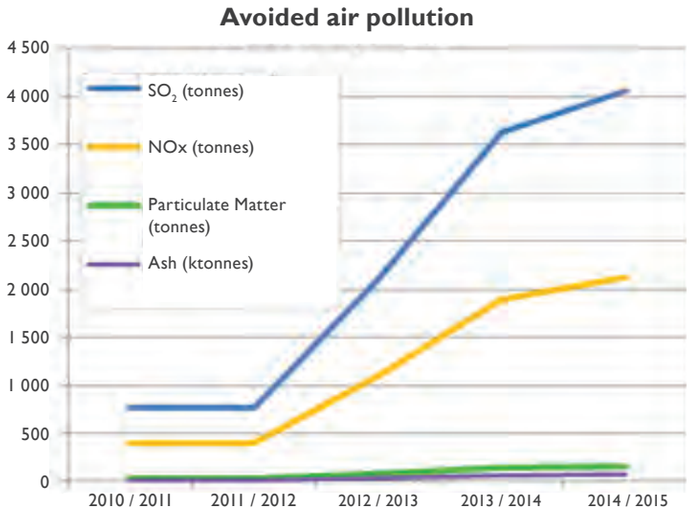
General details of the response measure	
Name of response measure	Department of Energy's (DoE's) Municipal Energy Efficiency and Demand Side Management (EEDSM) Programme.
Project description / snapshot	This is a government funding programme aimed at promoting the implementation of more energy-efficient technologies, processes and behaviours for municipalities. The funding comes from National Treasury and is managed by the Department of Energy and is available to municipalities as a grant.
Primary intended outcome	Reduction in electricity demand in municipalities and reduction of GHG emissions.
Progress to date	
Implementation plan	The programme has been in place since 2009 and over the years, it has evolved and been extended.
Climate change mitigation impact of the programme	 A total of 0.5 $MtCO_2$e has been saved through this programme since its inception. The maximum annual emission reductions realised were 0.17 $MtCO_2$e in 2014/15. Annual emission savings are expected to reach 0.27 $MtCO_2$e by 2017/18.
Direct job creation	No information

Other sustainable development benefits	**Energy savings, water savings & coal savings**  **Avoided local air pollution**  Since 2009, the programme has saved a total of 700 million litres of water, 500 gigawatt hours of electricity and 265 kilotonnes of coal. Also due to the programme the emission of 4.2 kilotonnes of SO_2, 2.2 kilotonnes of NOx, 167 tonnes of particulate matter and 77 kilotonnes of ash have been avoided.
Source of data used	Department of Energy Clean Energy unit

1.3 National Cleaner Production Centre's Industrial Energy Efficiency Improvement Project

General details of the response measure	
Name of response measure	National Cleaner Production Centre's (NCPC's) Industrial Energy Efficiency Improvement (IEE) Project.
Project description / snapshot	This project is implemented by the NCPC and is designed to help transform industry energy use patterns, helping industries to adopt a more systematic and holistic approach to energy management within their organisations and plants. Companies participating in this programme have access to technical specialists in the respective fields to undertake assessments of their processes in order to identify improvement options for implementation.
Primary intended outcome	Facilitate resource efficiency and cleaner production in industry, specifically in the areas of energy, water and materials.

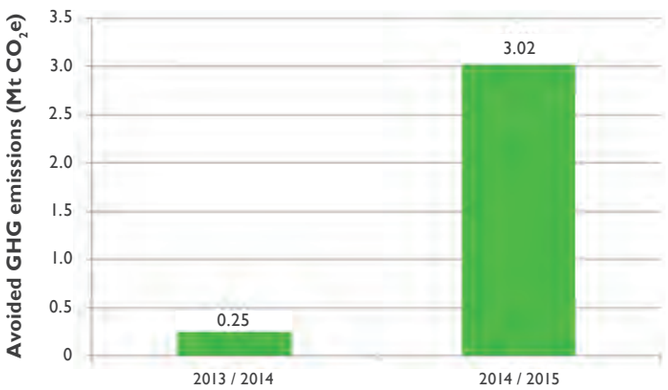
Progress to date	
Implementation plan	Initiated in 2010
Climate change mitigation impact of the programme	 A total of 1.34 $MtCO_2$e have been saved in this programme since its inception. The maximum annual emission reductions realised were 0.48 $MtCO_2$e in 2014/15.
Direct job creation	No information

Other sustainable development benefits	  Since 2010, the programme has saved a total of 1 900 million litres of water, 1 300 gigawatt hours of electricity and 711 kilotonnes of coal. Due to the programme the emission of about 11.3 kilotonnes of SO_2, 5.9 kilotonnes of NOx, 448 tonnes of particulate matter and 208 kilotonnes of ash have been avoided.
Source of data used	National Cleaner Production Centre

2 ELECTRICITY GENERATION

2.1 Renewable Energy Independent Power Producer Procurement Programme (REIPPPP)

General details of the response measure	
Name of response measure	The DoE's Renewable Energy Independent Power Producer Procurement Programme (REIPPPP).
Project description / snapshot	The REIPPPP includes a competitive bidding process whereby the lowest bidders are awarded long-term power purchase agreements at the offered price in ZAR/MWh for the renewable energy their projects supply to the South African electricity grid.
Primary intended outcome	Energy security (especially electricity supply) through renewable energy sources.

Progress to date	
Implementation plan	Four bidding windows have been completed, totalling 92 projects with a combined generation capacity of 6 327 MW.
Cost of implementation	The total project cost is R192.6 billion.
Climate change mitigation impact of the programme	 By March 2015, generation capacity of 1 860 MW had been built and a total of 3.3 TWh of electricity had been produced by the REIPPPP projects, leading to a total GHG mitigation figure of about 3.27 $MtCO_2e$.
Direct job creation	To date the programme has created a total of 19 050 RSA-based job opportunities for citizens, with 18 195 opportunities created during construction and 855 for operations.

Other sustainable development benefits

The other sustainable development indicators being monitored in this programme are:

- value of local content (%): 48% achieved
- enterprise development: R30.7 million, of which R25.5 million is based in local communities
- socio-economic development: R76.7 million, of which R67.6 million is based in local communities

Year	Avoided SO_2 (t)	Avoided NOx (t)	Avoided Particulate Matter (t)	Avoided Ash (kt)	Water saved (ML)	Coal Saved (kt)
2013/14	2 136	1 115	85	39	355	134
2014/15	25 414	13 266	1 006	468	4 223	1 599
	27 550	**14 381**	**1 091**	**507**	**4 578**	**1 733**

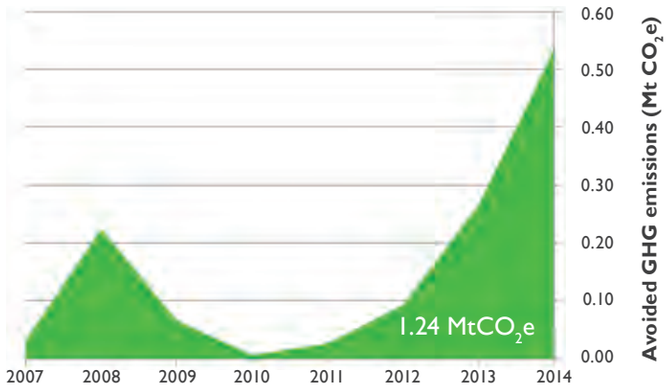
Source of data used

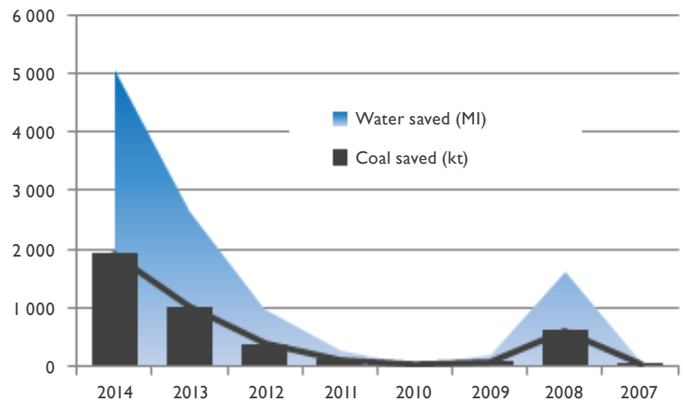
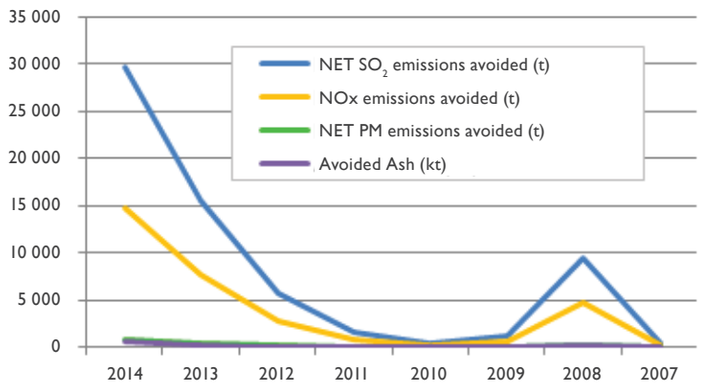
IPP projects

Hopefield Wind Farm, Hopefield

2.2 Eskom's Open Cycle Gas Turbines

General details of the response measure	
Name of response measure	Eskom's open cycle gas turbine power generation.
Project description / snapshot	This is the generation of electricity from open cycle gas turbines (OCGTs) using liquid fuels (mostly diesel). Eskom has had small gas turbine power plants since 1976, which are used as peaking power plants. In 2007, however, a much bigger power plant – Ankerlig – was built in the Western Cape. While also built to address increasing peaking power demands, the plant has been operated beyond power peaking times in recent years due to national power shortages.
Primary intended outcome	Peak power electricity supply.

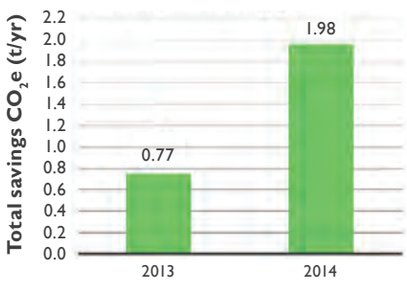
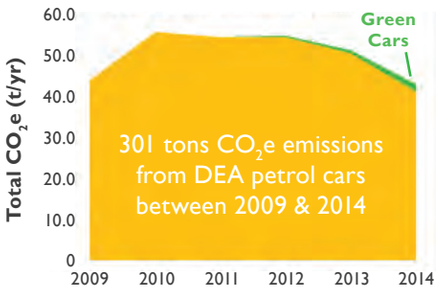
Progress to date	
Climate change mitigation impact of the programme	 Total GHG mitigation of 1.24 $MtCO_2e$ has been achieved through electricity generation using OCGTs between 2007 and 2014. Owing to increasing electricity demand and Eskom's struggle to keep up with it, OCGTs have been used more frequently. In 2014, a total of 3 621 GWh (net) was produced from OCGTs, leading to GHG emissions abatement of 0.53 $MtCO_2e$, compared to coal-based electricity.
Direct job creation	No information

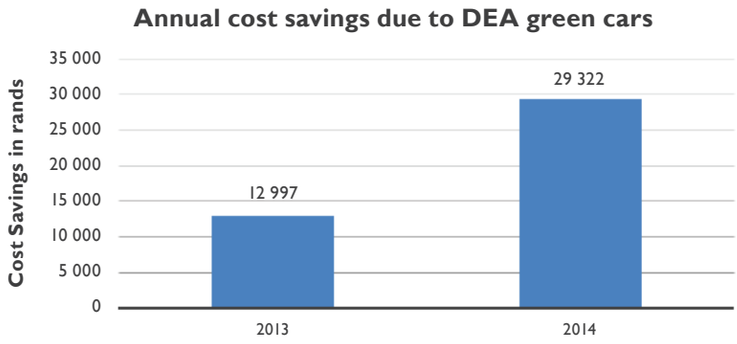
Other sustainable development benefits	**Water and Coal Savings due to Eskom OCGTs**   Since 2007, the programme has saved a total of 10 958 million litres of water and 4.1 million tonnes of coal. Due to the programme the emission of about 63.8 kilotonnes of SO_2, 32 kilotonnes of NOx, 1.9 kilotonnes of particulate matter and 1.2 million tonnes of ash have been avoided. Information on the number of jobs created was not available.
Source of data used	Eskom (2012) and Eskom (2015)

3 TRANSPORT

3.1 DEA Green Cars

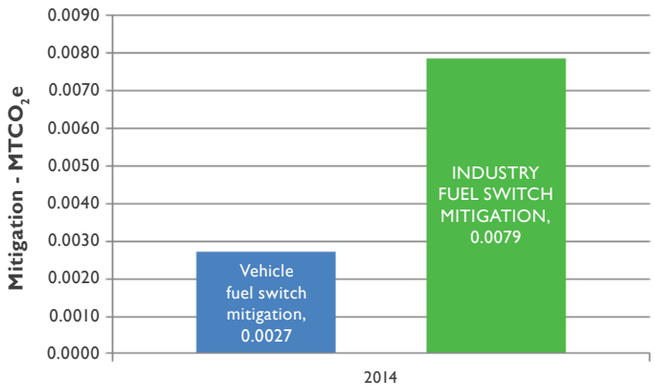
General details of the response measure	
Name of response measure	Department of Environmental Affairs Green Cars.
Project description / snapshot	This is a Department of Environmental Affairs (DEA) response measure to move away from using internal combustion vehicles to using electric vehicles. DEA employees drive these cars for trips within the Pretoria area.
Primary intended outcome	To reduce greenhouse gas emissions from the conventional Departmental cars used by employees.

Progress to date	
Implementation plan	The DEA Green Cars started its pilot in 2011 with three vehicles. Currently the Department has eight green cars.
Cost of implementation	The cost of implementation was R3.5 million and for the leased cars R2.9 million was paid over a 36 month period. Each car costs R460 000, while the charging system was costed at R360 000 (1 x quick charger @ R320 000 + 2 x slow chargers @ R20 000 each).
Climate change mitigation impact of the programme	**Annual GHG emission savings (tCO_2e/yr)**  **DEA Cars GHG emissions profile**  The DEA green cars achieved GHG savings of 0.77 and 1.99 tonnes CO_2e in 2013 and 2014 respectively. This corresponds to approximately 1.4% and 4.6% reduction in GHG emissions from all DEA vehicles in 2013 and 2014 respectively.

Cost saved	 In terms of fuel costs only, the green cars have saved the Department about R13 000 and R29 300 in 2013 and 2014 respectively.
Direct job creation	No direct jobs created.
Other sustainable development benefits	Not estimated.
Challenges	Range limitations of approximately 150 km / charge. This can, however, be overcome with availability of charging infrastructure and proper trip planning and obviously the vehicles were initially designed for urban use. The cost of the car is quite high, however, it is evident from the MPA that cost of implementation could be high but has quite high mitigation potential.
Lessons learnt	It will be ideal if the policy makers can encourage charging green cars using renewable energy. Government should subsidise the price of cars to encourage people to move from conventional cars to green cars.
Sources of data used	DEA transport unit

3.2 Compressed Natural Gas (CNG) Programme

General details of the response measure	
Name of response measure	Compressed Natural Gas use in the transport sector.
Project description / snapshot	The project aims to produce compressed natural gas (CNG) as an alternative energy source for industry and fuel for vehicles. Apart from SASOL, there are two companies in South Africa that sell CNG to industry and the vehicle industry.
Primary intended outcome	• reduce vehicle fuel costs through improved efficiency • climate change mitigation through reduced GHG emissions

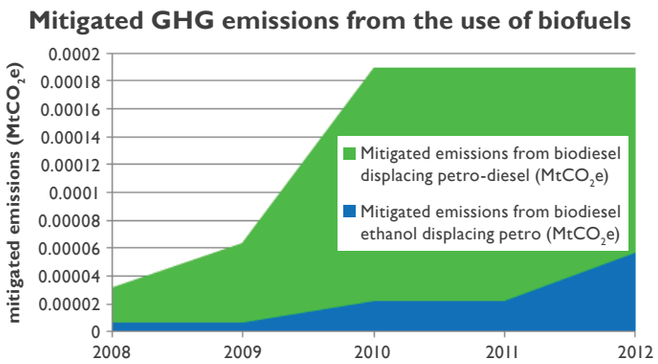
Progress to date	
Implementation plan	Information for assessment was only available from CNG Holdings, in which the government Industrial Development Corporation is a shareholder: • programme started in March 2014 • 400 taxis converted to date (June 2015) • one flagship filling station opened in Langlaagte (203 500 litres equivalent gas dispensed per month) • approximately 380 vehicles fill up at the station daily (of which about 370 are taxies)
Climate change mitigation impact of the programme	 An estimated total of 0.011 $MtCO_2e$ was mitigated through the fuel-switch to CNG in 2014. It is estimated that 0.0027 $MtCO_2e$ reductions were due to vehicle fuel switch while 0.0079 $MtCO_2e$ was as a result of fuel switch in industry. The industry fuel switch assessment is based on two companies that have switched to using CNG, for which data were available.

Other sustainable development benefits	Not enough information to quantify these.
Future plans/target plans	• convert 14 000 vehicles to run on gas • litres equivalent gas that will be dispensed is 7 700 000 per month (295 000 GJ per month) • capital required to fund taxis conversions is R273 million • open 28 company filling stations (each servicing 300–600 vehicles) • facilitate opening of 28 independently-owned CNG conversion & service stations (each able to convert between 2 to 10 vehicles a day)
Direct job creation	Currently a total of 24 staff members are employed at the filling station: • 17 attendants • 3 cashiers • 2 merchandisers • 1 manager • 1 book-keeper
Source of data used	Industrial Development Corporation

Future Plans	**28 Filling stations**
Fulltime	Jobs
Filling stations	448
Conversion workshops	470
Mother station to provide gas for natural gas vehicles (NVGs)	65
Construction and infrastructure	3 360
Total job creation	4 343

3.3 Biofuels

General details of the response measure	
Name of response measure	Biofuels production and consumption in the transport sector.
Project description / snapshot	The project aims to promote the production and consumption of biofuels (bioethanol and biodiesel) in South Africa to displace petro-diesel and petrol, with significant, measurable GHG reductions in the transport sector.
Primary intended outcome	To reduce direct greenhouse gas emissions from the conventional use of petro-diesel and petrol in the transport sector.

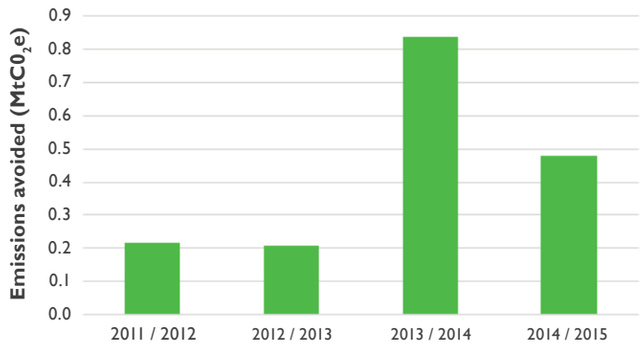
Progress to date	
Implementation plan	In 2007 South Africa launched the National Industrial Biofuels Strategy with a targeted 2% biofuels penetration. Thus far eight licences have been granted to produce biofuels on a large scale, however, the mandatory blending regulations have not yet come into effect and production will only start once these are finalised. According to international energy statistics, small-scale production and consumption of biofuels (bioethanol and biodiesel) commenced in South Africa in the year 2008 (with data available from 2008–2012).
Implementation cost	No information on costs.
Climate change mitigation impact of the programme	 It is estimated that at total of 6.1 million litres of biodiesel and 15.1 million litres of bioethanol were consumed as fuel for vehicles between 2008 and 2012, displacing petro-diesel and petrol respectively. The total mitigation impact of using the biodiesel and bioethanol is estimated at 0.00066 $MtCO_2e$ and 0.00011 $MtCO_2e$

Direct job creation	No information.
Other Sustainable Development benefits	Not estimated.
Challenges	Currently in the country there is no systematic mechanism to collect and monitor biofuels production. Until such a system is in place, issues of cost saving and direct job creation will not be measurable and reportable.
Source of data used	Statistics South Africa, 2015b

Corn fields - where the production of Bioethanol starts

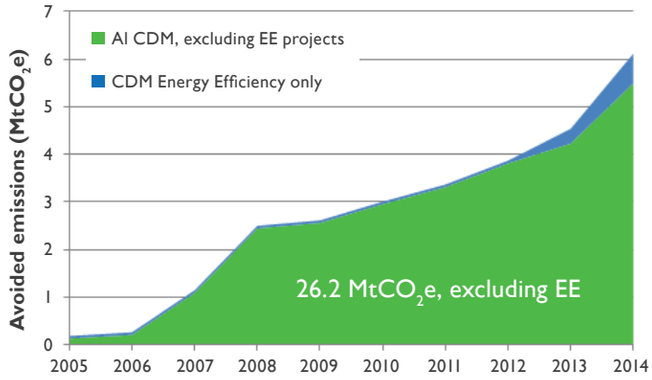
3.4 Transnet's Freight Road-to-Rail Programme

General details of the response measure	
Name of response measure	Transnet Road to Rail Programme and regenerative braking in locomotives
Project description / snapshot	Transnet's most significant energy efficiency gains are made in freight rail as the new locomotive technology is introduced into operations, specifically from regenerative braking capability. Transnet's Market Demand Strategy (MDS) targets increasing rail's market share from 23% in 2011/2012 to 35% by 2018/19.
Primary intended outcome	• reduce transport related emissions • improve energy efficiency • in addition reduce electricity costs
Progress to date	
Implementation plan	• Transnet concluded a number of locomotive contracts in 2015 which will result in the acquisition of approximately 1 200 new locomotives for the General Freight Business (GFB). To date the following locomotives have been delivered and accepted into service or are still undergoing testing: • 94 electric locomotives have been accepted into service while one is still undergoing fault-free trips testing and is expected to be in full use by the end of June 2015. • 25 diesel locomotives have been delivered and accepted into service, with an expected completion date of July 2015 for the remaining 35 locomotives. • 28 electric locomotives for the coal line have been received and are currently undergoing testing. The expected completion date is September 2015 for the remaining 72 locomotives.
Implementation cost	Transnet adopted a bold MDS from 2012/2013 to invest R3 001 billion in rail, port and pipeline infrastructure from 2012 to 2019.

Climate change mitigation impact of the programme	**Emissions avoided due to modal shift from road to rail**  Carbon emission savings in 2011/2012 were 0.22 MtCO$_2$e due to the modal shift from road to rail. The carbon emission savings in the top 10 road-to-rail volume gains was 206 540 tCO$_2$e in 2012/2013. ***Note:*** *The top 10 road-to-rail volume gains refers to gains in the automotive, timber, iron, chemicals, cement, chrome, coal, manganese, magnetite and container freight categories.*
Costs saved	R40 million was saved on the regeneration braking system
Challenges	No information
Other sustainable development benefits	No information
Source of data used	Transnet

4 CLEAN DEVELOPMENT MECHANISM PROJECTS

General details of the response measure	
Name of response measure	The Clean Development Mechanism (CDM)
Project description / snapshot	This is a mechanism of the United Nations Framework Convention on Climate Change's Kyoto Protocol, whereby developed countries (Annex 1) buy carbon credits generated by implementing lower-carbon programmes in developing countries. These credits then go towards helping developed countries to meet their Kyoto Protocol targets.
Primary intended outcome	Mitigating climate change

Progress to date	
Mitigation impact	 Since the Kyoto Protocol came into effect, a total of 27.6 $MtCO_2e$ of GHG emissions have been avoided due to implementation of CDM projects in South Africa, of which 1.4 $MtCO_2e$ is due to energy efficiency projects.
Direct job creation and other sustainable development benefits	Not enough information to estimate these.
Source of data used	UNEP DTU Partnership, 2015

5 DEA'S GREEN FUND PROGRAMME

General details of the response measure	
Name of response measure	Department of Environmental Affairs Green Fund Programme
Project description / snapshot	The Green Fund aims to provide catalytic finance to facilitate investment in green initiatives that will support poverty reduction and job creation The Green Fund is additional and complementary to existing fiscal allocations supporting the transitioning of the South African economy to a low-carbon, resource efficient and climate resilient growth path. The Green Fund responds to market weaknesses currently hampering South Africa's transition to a green economy by: • promoting innovative and high impact green programmes and projects • reinforcing climate policy objectives through green interventions • building an evidence base for the expansion of the green economy • attracting additional resources to support South Africa's green economy development The DEA has appointed the Development Bank of Southern Africa (DBSA) to manage, monitor and evaluate the fund.
Primary intended outcome	Provide catalytic finance for investment in green initiatives

Progress to date	
Mitigation impact	The DBSA has recently developed and implemented a monitoring system for this fund covering social, environmental and economic project impact indicators. In 2015 the DBSA reported the following climate change information:

Indicator	Units	Achieved	Potential
Carbon emission reduction	Tonnes (CO_2)	21 856	100 693
Renewable energy installed capacity (share of power supply)	Installed capacity (MW)	-	4

Job creation and other sustainable development benefits

The table below summarises the achieved sustainable development co-benefits from the implementation of the Green Fund, as well as the potential impact over the life-time of the projects:

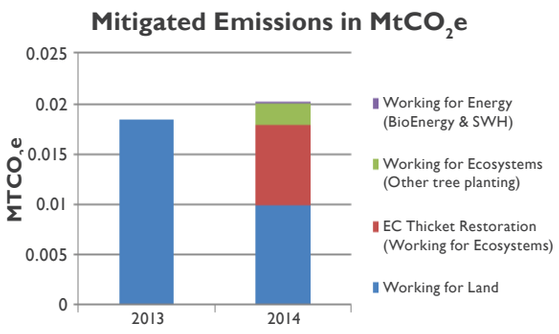
	Indicator	Units	Achieved	Potential
Economic	New economic entities created	No of entities	11	241
	Revenue generation – value of sales generated	Rand	3 419 010	206 133 235
	Asset base	Rand	19 762 067	206 102 215
	Private sector participation in green industries	Rand	44 765 067	261 050 000
	Direct investment (foreign and local)	Rand	259 505 563	748 358 900
	Leveraging of other investment funds	Rand	9 128 111	292 200 000
Social	Direct jobs created	Number	1 378	14 957
	Indirect jobs	Number	6 117	76 735
	Green jobs skills training – people trained	Number	6 291	33 570
Environmental	Area protected – land & marine conservation area	Hectares	30 008	1 015 019
	Area of land restored	Hectares	16 375	24 455
	Diversion of toxic waste from water resources	Kilograms	1	5
	Number of protected birds or animals	Number	1 245	50 000
	Total energy saved	kWh	107 648	2 683 944
	Increase in waste collection	kg waste/yr	9 462 098	53 494 000
	Waste diverted away from landfills	kg	8 500 948	48 195 200

Source of data used

DBSA

6 EXPANDED PUBLIC WORKS PROGRAMME

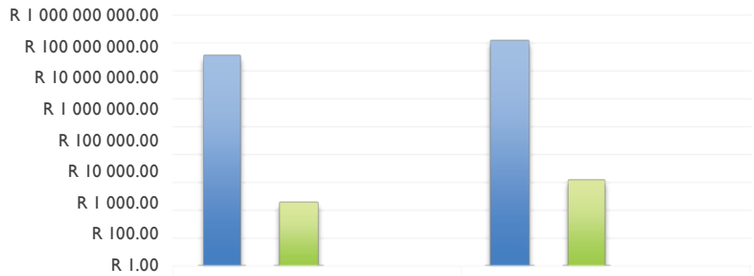
General details of the response measure	
Name of response measure	Expanded Public Works Programmes (Working for Ecosystems, Working for Land and Working for Energy)
Project description / snapshot	The Working for Land and the Working for Ecosystems Programmes aim to encourage and support sustainable land use practices, raise awareness and promote resource conservation, with significant mitigation benefits associated with their implementation. The two programmes presented here in particular include the Eastern Cape Sub-Thicket Restoration programme (Spekboom restoration and other tree planting), and the Environmental Protection and Infrastructure Programmes (EPIP) (including all greening and open space management programmes that implement tree planting initiatives across EPIP programmes). The Working for Energy Programme, on the other hand, is primarily intended to demonstrate the application of renewable energy to address energy poverty mainly in outlying areas located in and beyond the fringes of mainstream service delivery areas.
Primary intended outcome	The primary outcome across these programmes is to create labour intensive and sustainable jobs through protection and rehabilitation of green infrastructure/ecosystems (working for ecosystems and land), whilst Working for Energy aims to demonstrate applications of renewable energy technologies.

Progress to date	
Climate change mitigation impact	For this assessment, only data for 2013 and 2014 on the following projects was available: • Working for Ecosystems (Eastern Cape thicket restoration and other tree planting) • Working for Land • Working for Energy (3 x biogas digesters and solar water heaters)  About 0.038 $MtCO_2e$ of GHG emissions was mitigated from these projects for the 2013–2014 period. The largest contribution to climate change mitigation in these programmes was due to planting trees in both the Working for Land and Working for Ecosystems programmes. ***Note:*** *It is realised that significant mitigation benefits can be realised in the Working for Water, Working for Wetlands and the Working on Fire programmes. This information will be quantified and presented in next year's financial report*

Cost saved	Working for Energy: Annual cost savings per household from using biogas is approximately R46 956.

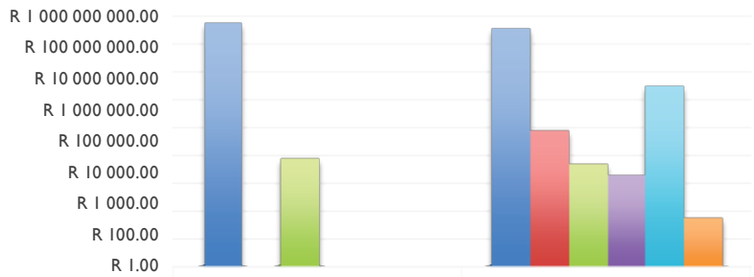
Direct job creation and costs of implementation

Annual Programme Costs and Job Creation*



	2011	2012
Costs EPIP	R 40 109 757.00	R 135 917 016.00
Costs Working for Ecosystems	R 0.00	R 0.00
Jobs EPIP	200	1332
Jobs WfEcosystems	0	0
WF Energy Costs	R 0.00	R 0.00
Jobs WfEnergy	0	0

graph continued from above...



	2013	2014
Costs EPIP	R 637 633 328.00	R 381 531 060.18
Costs Working for Ecosystems	R 0.00	R 81 296.77
Jobs EPIP	7890	5126
Jobs WfEcosystems	0	1969
WF Energy Costs	R 0.00	R 3 156 148.13
Jobs WfEnergy	0	65

**Costs and jobs created are specific to those projects with mitigation activities (namely tree planting and renewable technologies) and do not reflect the costs and jobs created through all the EPIP and other EPWP programmes.*

Other sustainable development benefits	**Working for Energy** • reduced coal use • reduced water use • reduction in ash produced • reduced particulate emissions • SO_2 emissions reduction • NOx emissions reduction **Working for Ecosystems and Land** • improved air quality (particulates removed from the air) • ecosystem functioning and biodiversity protection • reduced wildfire and drought risk from removal of invasive alien plants • improved health and wellbeing There was not enough information for the actual assessment of these impacts to be carried out.
Challenges	Quantifying impacts, beyond just job-creation (namely mitigation benefits and other SD benefits) of all EPWP programmes needs specific data and information that is currently not being collected and monitored in the EPWP reporting systems.
Source of data used	DEA Environmental Programmes branch; SANEDI – Working for Energy unit

ANNEXE 2: IMPACT FACTORS USED IN ASSESSING SUSTAINABLE DEVELOPMENT CO-BENEFITS OF MITIGATION MEASURES

In general the sustainable development co-benefits (or co-costs) of implementing the various mitigation response measures were assessed as follows:

A. Decoupling economic growth from environmental degradation

1. Sulphur oxides (SOx)
2. Nitrogen oxides (NOx)
3. Particulate matter
4. Ash

These have been assessed only for programmes that reduce or avoid the use of electricity. The following emission factors were used in the assessment:

Environmental impacts based on Eskom electricity								
Year	GWh electricity sold	SO_2		NOx		Particulate Matter		Ash
		kt	g/kwh	kt	g/kwh	kt	g/kwh	g/kwh
2011	224 446	1 810	8.06	977	4.35	75.84	0.34	
2010	218 591	1856	8.49	959	4.39	88.27	0.40	
2009	214 850	1 874	8.72	957	4.45	55.64	0.26	
AVERAGE			8.43		4.40		0.33	155

Source: http://financialresults.co.za/2011/eskom_ar2011/add_info_tables.php

B. Saved resources – Decoupling economic growth from resource utilisation

Water and coal saved are the two indicators that have been assessed under this group. The assessment has been carried out for savings in electricity usage only, based on coal and water used by Eskom as shown in the table:

Resource utilisation based on Eskom electricity			
Year	GWh electricity sold	Coal saved	Water saved
		kt/kwh	l/kwh
2011	224 446	0.53	1.40

Source: http://financialresults.co.za/2011/eskom_ar2011/add_info_tables.php

C. Economic benefit: Cost-saving

Only costs saved for the DEA green cars were assessed in this report. The electricity tariffs and fuel costs below were used for the assessment:

Year	Petrol price (R/litre)	Electricity price (R/kWh)
2012	11.6	1.00
2013	13.8	1.06
2014	12.6	1.15

D. Job creation: Number of jobs created

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