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Creating Incentives for Green Economic Growth: Green Energy in South Africa

Lesley Wentworth

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African perspectives. Global insights.

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Programme head: Catherine Grant, catherine.grant@saiia.org.za

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ABSTRACT

Green economic growth is constructed around six main sectors: green or renewable energies; green and energy-efficient buildings; clean transportation; water management and conservation; waste management, including recycling; and land management, including multiple land use.

Green energy, though, is at the heart of the green economy in the twenty-first century. The threat of disruptive climate change has directed attention on the central role that energy plays in shaping the future interaction between humans and the natural resources on which they are dependent.

It is vital that renewable energy sources and green industries become more competitive relative to the entrenched fossil fuels, thus enhancing the attractiveness of investing in the green economy. When applied appropriately, economic incentives can accelerate the turning point of the transition from a high-carbon, fossil fuel-based economy to a less carbon-intensive one that encourages innovation and efficiency.

The vertically integrated power utility in South Africa has had a monopoly backed by state-ownership of generation, distribution and supply of electricity. Owing to sunken costs in its old technology, it has been anything but agile in responding to calls to move from dirty-energy coal production. However, there are signs that government policy has finally stirred this giant relic into competing with the new, especially foreign, entrants into the renewables market.

ABOUT THE AUTHOR

Lesley Wentworth is a programme manager in the Economic Diplomacy Programme of the South African Institute of International Affairs (SAIIA).

ABBREVIATIONS AND ACRONYMS

2DS	2°C Scenario
BBBEE	broad-based black economic empowerment
BRICS	Brazil, Russia, India, China, South Africa
CDM	Clean Development Mechanism
CEO	chief executive officer
CER	certified emission reduction
CO_2	carbon dioxide
CSP	concentrated solar power
CSIR	Council for Scientific and Industrial Research
DEA	Department of Environmental Affairs
DoE	Department of Energy
dti	Department of Trade and Industry
ERCC	Emergency Response Command Centre
ESCo	Energy Service Company
FDI	foreign direct investment
GDP	gross domestic product
GEER	Green Energy Efficiency Fund
GHG	greenhouse gas
GW	gigawatt
GWh	gigawatts per hour
IDC	Independent Development Corporation
IDM	Integrated Demand Management
IEP	Integrated Energy Plan
IPAP2	Industrial Policy Action Plan II
IPP	independent power producer
IRP	Integrated Resource Plan
ISMO	independent system market operator
kWh	kilowatt hour
LTMS	Long-Term Mitigation Scenarios
MW	megawatt
NDP	National Development Plan
NER	National Electricity Regulator
NERSA	National Energy Regulator of South Africa
NGP	New Growth Path
NIP	National Infrastructure Plan
PPA	power purchase agreement
PT	parabolic trough
PV	photovoltaic
REFIT	renewable energy feed-in tariffs
REFSO	Renewable Energy Finance Subsidy Office
REIPPP	Renewable Energy Independent Power Producer Procurement Programme
REMT	Renewable Energy Market Transformation
SEA	strategic environmental assessment
SEZ	special economic zone
SMA	SMA America Solar Technology
SPA	special pricing agreement
TES	thermal energy storage

TRANSITION TO GREEN: THE SURVIVALIST IMPERATIVE

The 2°C Scenario (2DS) considers the global energy system in an outcome where climate science research indicates that the emissions trajectory would provide an 80% chance of restricting the increase in average global temperature to 2°C.[1] This scenario aims to reduce energy-related carbon-dioxide (CO_2) emissions by more than half by 2050 (compared with 2009). This scenario also includes the objective that emissions continue to fall after 2050. Importantly, the 2DS acknowledges that the transformation of the energy sector is an essential, but not the sole, solution: the goal can only be achieved provided that CO_2 and other greenhouse gas (GHG) emissions in non-energy sectors are also reduced.[2]

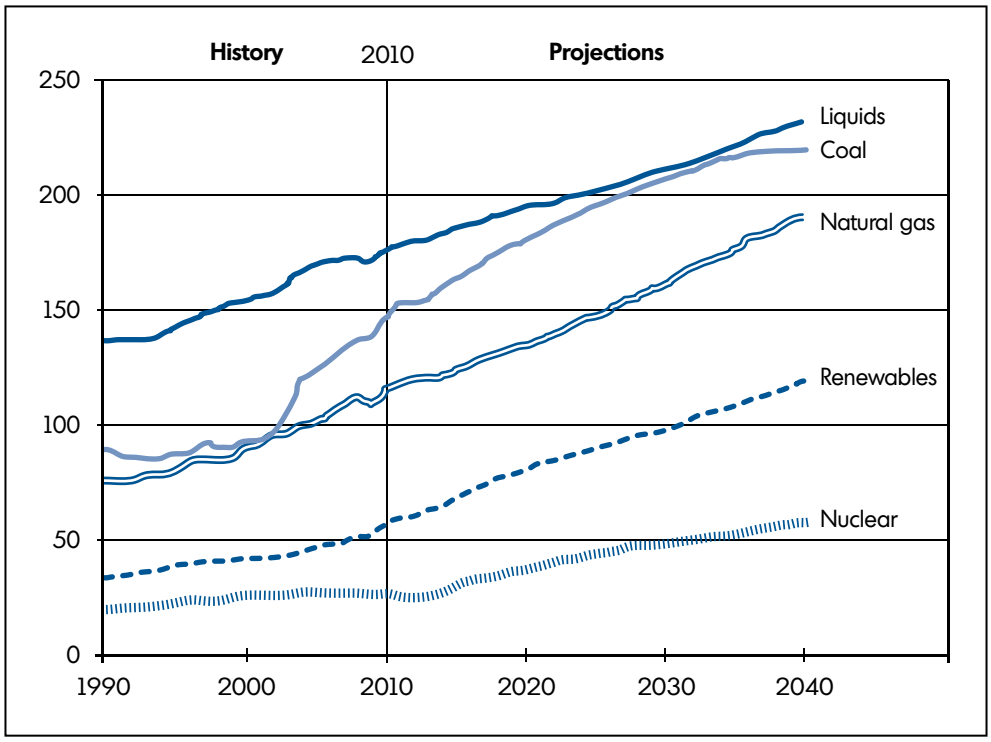
The Intergovernmental Panel on Climate Change associates the 2DS with a stabilisation of GHG concentration between 400 and 450 parts per million (gases such as CO_2 and chlorofluorocarbons as a ratio to the earth's atmosphere). The necessary rate of renewables deployment to achieve this stabilisation level depends on various factors, including overall energy consumption, the uptake of energy efficiency measures, and the choice of conventional fuels and their respective carbon intensities. Various scientific model scenarios, such as the 2DS, require deployment of renewable energy technologies to increase the global share of renewables up to about 43% by 2030 and 77% by 2050.[3]

The Rio+20 Conference in 2012 has given impetus to the 'green growth', 'green economy' and 'sustainable development' movements – whether understood as competing ideas or synergistic ideals.[4] Many governments have begun to look at how to facilitate the growth of greener industries; and how, more specifically, to promote renewable green industries such as wind turbines or solar energy.

Still, green economic growth is fashioned around five other main sectors besides green or renewable energies. These are: green buildings, including green retrofits for energy and water efficiency; clean transportation utilising alternative fuels, hybrid and electric vehicles; water management, including water demand management and conservation, water reclamation, purification and recycling such as industrial and domestic effluent (grey water); waste management, including recycling, municipal solid waste salvage, brownfield remediation and sustainable packaging; and land management, including organic agriculture, habitat conservation and restoration, urban forestry and parks, reforestation and afforestation, and soil stabilisation and multiple land use.[5]

Green energy, though, is at the core of the green economy in the twenty-first century. The threat of disruptive climate change has directed attention to the central role that energy plays in shaping the future interaction between human beings and the natural resources on which they depend. Brookings researchers stated this aptly: 'Energy is not just any other ingredient in economic growth; it is the irreplaceable ingredient that makes that growth possible.'[6] Fossil fuel use will still account for a large proportion of energy use in 2035 – if governments were to implement at least some of their climate and energy efficiency commitments. The link between energy and economic growth will not be broken, although, hopefully, the world will continue to improve its ability to eek higher gross domestic product (GDP) out of fewer natural resources.[7]

Figure 1: World energy consumption by fuel type, 1990–2040 (quadrillion British Thermal Units)



Source: EIA (United States Energy Information Administration), 'International Energy Outlook 2013' Department of Energy/EIA-0484(2013). Washington, DC: EIA, 25 July 2013, http://www.eia.gov/forecasts/ieo/world.cfm, accessed 9 May 2014

It is vital that renewable energy sources and green industries become more competitive relative to the entrenched fossil fuel technology, thus enhancing the attractiveness of investing in the green economy. When applied appropriately, economic incentives can accelerate the transition from a high-carbon, fossil fuel-based economy to a less carbon-intensive one that encourages innovation and efficiency. For fast-growing emerging economies, such as South Africa and its Brazil, Russia, India and China (BRIC) peers, it is time to transform the rhetoric concerning the emerging economy challenge to the old and established economic order into focused action. In this emerging economy group South Africa has a unique energy history which, hopefully, will transform into a sustainable energy future.

SOUTH AFRICA'S ENERGY SITUATION

On 6 March 2014 darkness fell in South African centres, including in the greater Johannesburg area – the country's economic hub. Later that day, Eskom, South Africa's power utility, declared the fourth energy emergency since the beginning of the 2014 calendar year. Immediate fears were that there would be a repeat of the South African electricity crisis of 2008. Again, this time around, Eskom explained that the antiquated

power stations and resulting boiler tube leaks were the primary reasons behind generator outages. In addition, power stations in the Mpumalanga Province were further challenged due to the continuous and heavy rainfall over the week leading up to 6 March, which had an impact on the quality of the coal. In a press briefing the following day, the outgoing Chief Executive Officer (CEO) of Eskom, Brian Dames, outlined how the power utility was in a better position in 2014 to deal with the fallout of the very similar circumstances (albeit six years apart) leading to the country's electricity outages.[8]

Table 1: Management of energy crises, 2008 and 2014

Activity	2008	2014
Communication of system status	Inadequate pre-communication of system constraints	• Proactive communication (quarterly system updates, summer or winter communication) • Improved communication with customers, media and other stakeholders
Executive management oversight (pre-incident)	Inadequate integration between functions prior to the incident	Executive team assigned, Emergency Response Command Centre (ERCC) established, weekly reviews, alignment with shareholders
Country demand reduction protocols	No country protocol in place	National Code of Practice, based on multi-stakeholder input, approved by the National Energy Regulator of South Africa (NERSA)
Load shedding (small customers)	Schedules developed during the critical constraint	Prepared and published by Eskom and metropolitan councils before the emergency as per the National Code of Practice
Load curtailment (large customers)	No pre-agreement	Signed curtailment agreements
Preparedness	Limited exercises and tests	Regular operational and two national multi-stakeholder exercises
Visibility	Limited visibility of key processes	Detailed information via Generation and Customer nerve centres, and National Control Help Desk
Declaration of an emergency	Once system was nearing instability	In line with the National Code of Practice
Coal supplies	Unhealthy levels – on average, below ten days no wet coal	• Healthy levels – on average, at 45 days • Wet coal procedures in place

Source: Media briefing by the then CEO of Eskom, Brian Dames, held at Megawatt Park, Sunninghill, Johannesburg, on 7 March 2014

Brief chronology ... heading towards an energy crisis

Shortly after 1994, when the African National Congress-led government took over the political reins in South Africa, an outcry from Eskom outlined the clear danger that electricity supply would catch up with demand by 2007. The government decided to put off increasing capacity through new construction and rather gave priority to providing access to residential consumers. The former apartheid government had gone on a power plant-building spree in the 1970s and 1980s, but the consumer base was much smaller then. Many of the plants built in this era were mothballed and remained unused for decades. It should be recalled that a large proportion of households in black urban townships and rural areas were excluded from access to electricity by South Africa's apartheid policies. Moreover, the country's economic isolation due to sanctions in the 1980s limited its development and economic growth through capital disinvestments.

With the start of democracy, the new government worked steadily at addressing backlogs and providing power to the previously excluded households via the provision of electric lighting in their homes. By 2007 some 4.2 million additional households were connected to the national grid.[9] In addition, the government's political and economic liberalisation policies resulted in international interest and substantial foreign investment – rising from $15 billion in 1995 to $132 billion in 2010.[10] Clearly, the need for additional energy was dire by the time the 2008 crisis and subsequent load-shedding[11] power interruptions set in. At this point South Africa's reserve margins were, on average, between 8 and 10%; where typically reserve margins should be around a comfortable 15%.[12]

The March 2014 crisis was handled relatively quietly, given the crisis management systems in place at Eskom under the emergency procedures in force (see Table 1), imposing 10% reductions in usage for key industrial clients and entreating domestic users to reduce power usage and turn off non-essential appliances, in order to avoid triggering load shedding again.

On the policy side, 1995 saw the establishment of the first National Electricity Regulator (NER), which was replaced with the National Energy Regulator of South Africa (NERSA) in 2006. In response to a Cabinet decision to restructure the electricity sector in 2001, the NER advocated an approach to reform the sector, including the corporatisation of Eskom; the corporatisation of generation and independent transmission; and the introduction of private sector involvement and competition.

In respect of these recommendations, the conversion of Eskom into a public company was completed in July 2002, creating three divisions: (1) Generation, (2) Transmission and (3) Distribution. However, these were not the separate, independent subsidiaries envisioned in the White Paper of 1998 (see discussion below). When the idea of an independent system market operator (ISMO) in the sector was mooted in 2004, Eskom responded by simply creating Eskom Enterprises Limited to fulfil this role, arguing that a new independent entity – a concept developed fully in the ISMO Bill 2012 – was not necessary.[13]

The price consumers pay for electricity in South Africa is determined by the regulator, NERSA. The level of output and capacity investments are determined by the Department of Energy (DoE). NERSA has approved an increase in tariffs of an average of 8% annually between 2013 and 2018. The lack of a demand–supply equilibrating price mechanism can, and has, led to market imbalances. When shortages were initially experienced in 1995,

gradual upward price adjustments should ideally have been considered. It is only since 2007 that electricity tariffs have been rising rapidly with the real electricity price more than doubling between 2007 to date.[14] Renewable technology started off prohibitively expensive to most households, but has been registering economies through constant innovation.

According to Nedbank Capital,[15] South Africa's cheapest power could be provided by solar power within the next seven years, according to a study commissioned by South Africa's Photovoltaic Industry Association. The cost of solar technology has become significantly cheaper. Estimates show that by 2020, Eskom will be selling coal-fired electricity at ZAR 1.69/kWh while the cost of solar-powered electricity could by then have fallen as low as $0.07c/kWh to $0.12c/kWh (ZAR 0.74/kWh to ZAR 1.26/kWh), with grid parity (competitive with the retail rate of grid electricity) arriving around 2018.

Expansion: A decade too late? Kusile and Medupi power plants

In 2007 the power utility had spent a decade constrained by electricity generation under-capacity – in its view through government's stalling with regard to adding new electricity generation capacity. Anticipating future shortages, Eskom was obliged to push through contracts to build two identical coal-fired power plants – Medupi and Kusile – each with a generating capacity of approximately 4 800 MW. In combination, once online, these plants are expected to represent about one-quarter of South Africa's power generation capacity.

Medupi is located in Lephalale, Limpopo Province. The power plant will have six units of 794 MW each with a total installed capacity of 4 764 MW. The first unit was scheduled to be commissioned in late-2012, with the last unit scheduled for commissioning by 2015. The coal for the power plant will be sourced from major coal miner, Exxaro Grootegeluk Mine, which will increase production by 14.6 million tonnes also a year to supply the new power plant, for an investment of approximately $893 million (ZAR 9.5 billion).

Kusile is located near Witbank in Mpumalanga Province. The plant will have six units of 800 MW each, with a total installed capacity of 4 800 MW. The first unit is planned for commissioning by 2013, and the other five units will follow within approximately eight-month intervals, with the last unit planned to be commissioned at the end of October 2016.[16]

Both of the power plants are currently under construction – Medupi has been subject to labour and contractor delays, leading to capital cost increases of around 15%.[17] Delays are anticipated for Kusile, which is scheduled to come online in the second half of 2014. This is because Eskom and Anglo American Nyosi Coal have not yet concluded negotiations over the coal supply contract with the colliery, New Largo, which is supposed to supply Kusile.[18]

Through its Eskom Power Investment Support Project, the World Bank has agreed to contribute $3.05 billion to finance supply, erection and civil construction contracts for the Medupi coal-fired power station and associated facilities, and $260 million for renewable energy projects – made up of 100 MW wind and 100 MW concentrated solar power (CSP). In addition, the development finance institution will provide $485 million for low-carbon energy efficiency components comprising road-to-rail conversion for coal transportation and power plant efficiency improvements.[19]

The World Bank has come under fire for supporting such a large coal development, while ostensibly engaged in supporting global climate action; for instance, the bank supports the UN's Green Climate Fund, which advocates carbon markets and low-carbon development. In response, the bank has stated that 'a rigorous analysis of the alternatives to coal-fired power plants was conducted; domestic or regional alternatives cannot meet the required base load capacity (9 600 MW over five years)'.[20]

South Africa's ambiguous relationship with coal

Fine and Rustomjee's description of the South African minerals–energy complex[21] considers the link between energy – principally supplied through coal extraction – and mining and minerals beneficiation,[22] which continues to absorb an estimated 44%[23] of the energy supplied in the country.

South Africa relies heavily on its large-scale, energy-intensive coal-mining industry as it has limited proven reserves of oil and natural gas,[24] and depends on large coal deposits to meet most of its energy needs, especially in the electricity sector. This is explained again by South Africa's isolation during apartheid and its need for energy self-sufficiency in the wake of international sanctions. Coal became the resource of choice for electricity and liquid fuel – hence the rise of the state-owned electricity utility, Eskom, and the state-owned oil company, SASOL. Coal was cheap and the persistent use of the old, established coal technology kept new investment costs to a minimum and the government paid off operating and mothballed assets. Competing technologies were essentially crowded out.

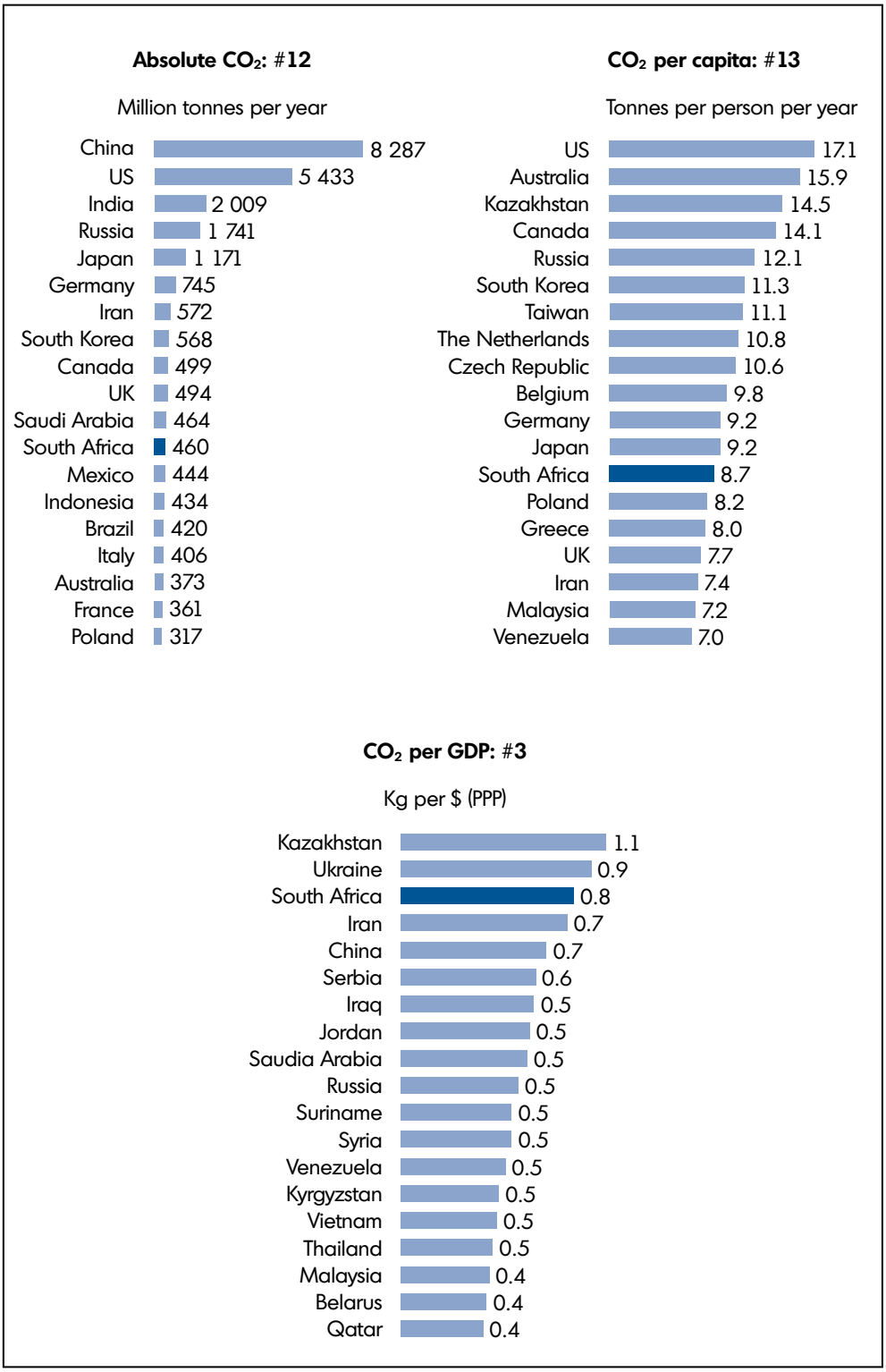
In 2009 the erstwhile Ministry of Minerals and Energy was split into two portfolios – a move that many welcomed as long overdue.[25] Clearly, in the former 'hyphenated' ministry, potential for conflict of interest abounded, especially in the light of the fixed price of electricity for energy-intensive users (or industrial subsidies) in the country. Eskom has been in a position to negotiate very favourable income and revenue contracts with coal-mining companies – cheap coal for cheap electricity.

Controversy erupted in 2013 when Eskom tried to renegotiate the special pricing agreements (SPAs) it had in place with BHP Billiton with respect to the miner's aluminium operations in Richards Bay, in KwaZulu-Natal Province, dating back to 1995 and 2001. Here the formerly secretive SPAs were brought into the public domain, revealing that mining companies were paying between about $0.02/kWh (ZAR 0.20/kWh) and $0.05/kWh (ZAR 0.56/kWh) respectively, whereas certain households paid up to $0.13/kWh (ZAR 1.40/kWh).

According to the US Energy Information Administration,[26] in 2012 South Africa's total primary energy consumption was made up of 72% from coal; 22% from oil; 3% from natural gas; nuclear represented 3%; and renewables, mainly hydropower, made up less than 1%. South Africa contributes about 40% of the African continent's GHG emissions and is responsible for 30% of the continent's consumption.[27]

South Africa's coal industry is noteworthy as a low-cost producer (along with Indonesia and Colombia). Apart from use in the domestic electricity supply chain, coal is also an important export. The country has the world's largest coal export terminal at Richards Bay and is located between Latin American and Asian Pacific sources. This gives the country the potential to be a 'swing producer', exporting competitively to either Europe or the East, depending on global economic conditions.[28]

Figure 2: Coal reliance makes South Africa one of the largest CO_2 emitters



PPP: Purchasing Power Parity

Source: Tobias Bischof-Niemz, analysis presented at SAIIA (South African Institute of International Affairs) Seminar, Johannesburg, 7 March 2014; based on UN, World Bank Statistics[29]

In April 2011 Eskom created a new organisational division, the Renewables Business Unit, to support its drive to diversify the utility's energy mix, along with establishing a research programme of investigating and harnessing South Africa's renewable energy resources for power generation. This is an encouraging signal for the development of the renewables sector as a whole, as it indicates Eskom's serious intention of engaging in non-coal alternatives.

Box 1: Mining: opting for renewables

Falling commodity prices, and the increasing costs of electricity from the grid and diesel for mining projects located far from the nearest electricity grid, have prompted mining companies to look towards renewable energies to offset fuel expenditure.

Capital costs for renewables have dropped significantly, so renewable solutions are in many instances cheaper than diesel. The renewable energy team at the Canadian engineering company Hatch has indicated that integrating hybrid power solutions – such as adding wind or solar to existing diesel systems – are able to cut mining companies' energy costs by 10–20%.[30] Renewable technologies are most attractive to mining projects in remote regions with little or no access to established electricity grids.

Cronimet Chrome Mining in South Africa has had the mining industry's first solar–diesel hybrid solution installed by SMA America Solar Technology (hereinafter SMA), a leading manufacturer of photovoltaic (PV) inverters and monitoring systems. SMA has clarified how solar systems can use intelligent communications systems to overcome stability challenges with the varying power depending on sunlight during the day. PV cannot replace diesel generators, especially for businesses that require power at night. Supplementing diesel generators with PV inverters presents significant fuel savings.[31]

Since operational expenditure on PV plants is relatively low, payback periods of four to five years are feasible in sunny regions. PV systems typically have life spans of around 20 years and thus represent a very good return on investment.[32]

Source: Information provided by Energy and Mines Canadian Conferences, http://www.energyandmines.com/case-studies/, accessed 2 June 2014

SOUTH AFRICA'S POLITICAL AND POLICY COMMITMENTS: BRIDGING TO 'GREEN'

International protocols

South Africa ratified the Kyoto Protocol[33] on 31 July 2002, but does not have the targets under the protocol that industrialised countries are assigned. The Clean Development Mechanism (CDM), in Article 12 of the Kyoto Protocol, allows a country with an emission

reduction or emission limitation commitment under the Kyoto Protocol (industrialised countries that are signatories to the protocol) to implement an emission reduction project in developing countries. Such projects can earn saleable certified emission reduction credits, each equivalent to one tonne of CO_2, which can count towards meeting Kyoto targets. 'Joint implementation' in Article 6 of the Protocol allows a country (industrialised countries listed in Annex B of the protocol) with an emission reduction or limitation commitment under the Kyoto Protocol to earn emission reduction units from an emission reduction or emission removal project in another Annex B party, each equivalent to a tonne of CO_2 (counting towards meeting its Kyoto target).[34]

At the UN Climate Change Conference in Copenhagen in 2009, South African President Jacob Zuma undertook that South Africa would reduce its emissions growth by 34% by 2020, and by 42% by 2025.[35] This was a voluntary – and very ambitious – pledge, in keeping with the objective recommended by the Long-Term Mitigation Scenarios (LTMS) approved by Zuma's Cabinet in 2008.[36]

South African Green Economy Policy Framework

The South African government has sent the correct signals indicating its commitment to endorsing a transition to greening the economy – essentially through embracing a more diversified energy mix away from coal reliance. Numerous economic policy documents, for instance those highlighted below, have direct reference to energy security, climate action or greener economic growth.

Policy documents linked to the green economy

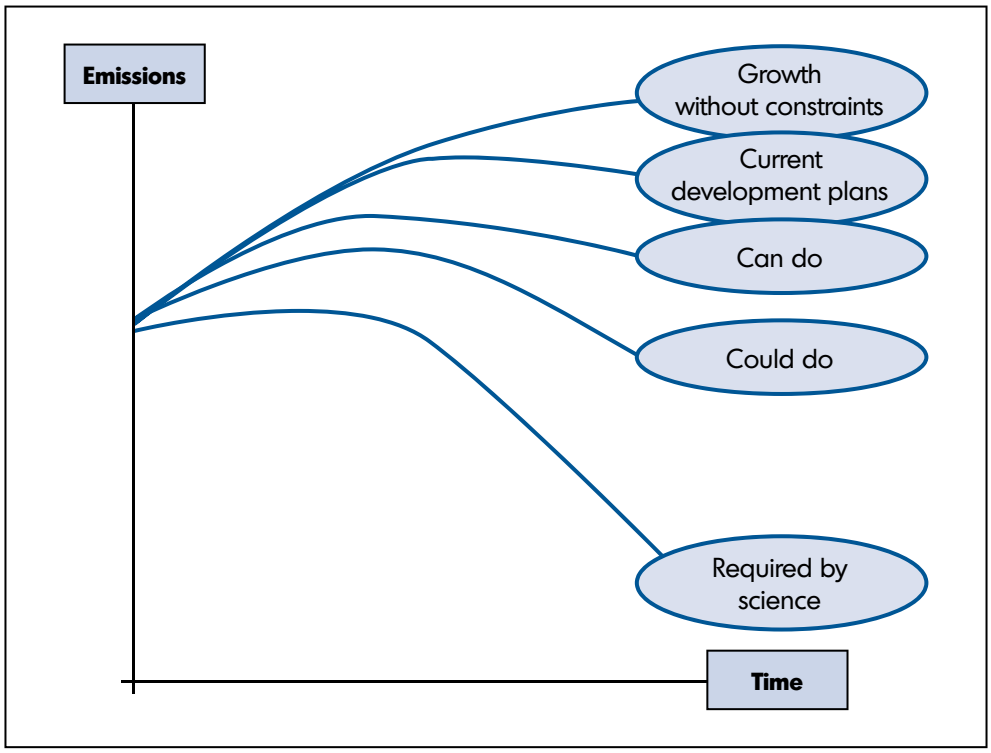
- National Development Plan, Vision 2030
- New Growth Path, Green Economy Accord and Green Jobs Report
- National Strategy for Sustainable Development and Action Plan
- 2009 South African Framework for Responding to Economic Crises
- 2009–2014 Medium Term Strategic Framework and 12 Outcomes
- Industrial Policy Action Plan
- National Climate Change Response Policy
- National Green Economy Summit and Programmes Reports
- Integrated Resource Plan and Integrated Energy Plan (IEP)
- National Water Resource Strategy
- Agriculture and Rural Development
- Transport and Human Settlement
- Ten-Year Innovation and Global Research Plan
- Environmental Fiscal Instruments (eg, carbon tax and green fund)
- National Skills Development Strategy 3.[37]

The *South African White Paper on the Promotion of Renewable Energy and Clean Energy Development: Part One – Promotion of Renewable Energy*, August 2002, was gazetted in May 2004 as the *White Paper on the Renewable Energy Policy of the Republic of South Africa*.[38] In this document government set a target on a renewable energy contribution at 10 000 gigawatts per hour (GWh) by 2013. The White Paper presents the move towards an uptake

of renewable energy in the economy, outlining objectives, including commitments that equitable resources are invested in renewable technologies; that public resources are directed towards the implementation of renewable energy technologies; that suitable fiscal incentives for renewable energy be put in place; and that an investment climate for the development of renewable energy sector be created.

The LTMS agreed to by the South African Cabinet in July 2008 set out the government's vision for a national climate policy and saw the government gaining the climate action 'high ground', given its aspirations to influence countries without emissions reduction plans of their own.[39] The modelling of potential emissions/growth outcomes was undertaken through comprehensive scenario planning by the Energy Research Centre on behalf of the Department of Environmental Affairs (DEA). The scenario examined the national and international contexts, considering a 'business as usual' approach, on the one hand; and an interventionist approach that would lead to required emissions reduction, on the other. Other scenarios are considered as options along this range (see Figure 3).

Figure 3: Long-term mitigation scenarios



Source: Winkler H (ed), *Long Term Mitigation Scenarios: Technical Report*, prepared by the Energy Research Centre for the Department of Environment Affairs and Tourism. Pretoria: DEA, October 2007

2006 National Treasury Framework for Environmental Fiscal Reform

This framework provides guidelines for fair and effective environmental taxes that have focused largely on taxes and levies on plastic bags and incandescent light bulbs; and costs

associated with ecosystem restoration in water use, liquid fuel, non-renewable electricity and new vehicle CO_2 emissions performance.

Carbon taxes have received a fair amount of attention in South Africa, especially since 2010 when the National Treasury released a discussion paper entitled 'Reducing Greenhouse Gas Emissions: The Carbon Tax Option'.[40] The subsequent Carbon Tax Policy Paper, 'Reducing Greenhouse Gas Emissions and Facilitating the Transition to a Green Economy'[41] was published for public comment in 2013, followed by the 'Carbon Offsets Paper'.[42] Alton *et al.*[43] submit that a long-term incentive for South Africa to support global mitigation involves the imposition of border carbon adjustments (carbon taxes) that place a burden on carbon-intensive imports. The authors expect that the adoption of this tax will be broadly accepted by leading economies in the near future, since Australia has already imposed such a measure (albeit with a repeal pending) and the US has had a carbon tax bill passed by the House of Representatives (although blocked by the Senate).[44] While South African legislation was expected to be enacted in 2015, a first delay announcement (to sometime in 2016) was issued in February 2014.[45]

National Strategy for Sustainable Development and Action Plan (2008)

The purpose of this framework is to develop a long-term commitment to sustainable development, combining environmental protection, social equity and economic efficiency. The five strategic objectives include (1) enhancing systems for integrated planning and implementation; (2) sustaining our ecosystems and using natural resources efficiently; (3) towards a green economy; (4) building sustainable communities; and (5) responding effectively to climate change.

2008 Energy Act and the Integrated Resource Plan[46]

The act, *inter alia*, requires that the government publish an IEP that is intended to give guidance to infrastructure development to ensure energy security in the country. The final drafting of the Integrated Resource Plan (IRP) for Electricity 2010–2013 was completed in 2010 and promulgated in May 2011, with the expectation that this policy document would be updated every two years. The first *IRP Update of 2013*[47] considers the electricity demand outlook, taking into account the desired economic growth predictions referred to in the government's strategy after 2010, for instance, the National Development Plan (NDP) and the National Infrastructure Plan (NIP) (see below).

The IRP Update considers various energy investment scenarios with recommended approaches, given certain qualifications. New developments in regional hydroelectric power and shale gas exploration are considered and conditions for the delay of nuclear rollout are explored. In the IRP Update, the latest assessment is that peak demand for electricity up to 2030 will, in fact, be 6 600 MW less than originally estimated in the IRP 2010 forecasts, due in part to the effects of the global economic recession. This lower demand is roughly equivalent to three of the proposed nuclear power stations – hence the possibility of delaying nuclear rollout to at least 2025, if not 2035.

Box 2: Global nuclear debate

The Fukushima Daiichi nuclear disaster resulting from the devastating earthquake and tsunami in Japan in March 2011 changed the public's acceptability of nuclear power globally.[48] Acceptance ratings of nuclear power fell from 57% to 49% in the aftermath of the accident at Fukushima and countries reviewed their nuclear energy policies. Germany, at the time relying on nuclear power for 23% of its electricity needs, shut down several older reactors and announced it would abandon all nuclear power plants by 2022. In 2010 the Merkel government changed the policy, extending the lifetime of nuclear facilities until 2030, reversing a decision of the previous administration in 2002. In the wake of the Fukushima accident, the early nuclear exit was enforced.

Costs associated with the construction of nuclear power plants increased worldwide after the Fukushima accident, based on demand for additional safety measures. The accident also saw stricter regulations of nuclear power plants being introduced around the world and are expected to cause longer construction times and an increased interest burden. Furthermore, the exposed risk is expected to raise the interest rates on loans for nuclear projects, potentially discouraging investors and lenders.

What about fracking?[49]

Fracking is a water-intensive process where millions of litres of water, sand and chemicals are 'drilled' to fracture underground rock that contains gas and oil. Shale gas has changed the US energy mix. The country's share of natural gas in terms of total energy consumption reached 26% in 2011 and by 2012 the US had achieved its lowest level of CO_2 emissions in 20 years.

There is debate around the environmental impact of shale gas, given the risk of chemical leakage into ground water, and chemical spills during extraction and seismic disturbances caused by hydraulic drilling. There is further concern over the leakage of methane (estimated at 20 times more damaging than CO_2) during the production of shale gas. Despite these concerns, energy experts tend to see this as a useful 'bridging' fuel on the way to a low-carbon economy if it is used as a substitute for coal.

It is perhaps in part on the back of the US' success at replacing coal and oil with shale gas that South Africa has been motivated to consider fracking in its arid Karoo region. The US Energy Information Administration estimates that South Africa has 390 trillion cubic feet of recoverable shale gas. With the country's reliance on the import of about 70% of its crude oil requirements, the shale discovery could change its energy mix as well.

While touted in Zuma's State of the Nation address as 'game changing',[50] shale gas fracking in the Karoo has come under the spotlight for failing to pay adequate attention to long-term health and environmental concerns raised by activists. In the Eastern Cape Province plans have been put in place for the massive exploration and production of shale gas in the Karoo Basin.

Table 2: Integrated Resource Plan 2010 Policy: Adjusted Plan with Ministerial Determinations

	New build options								Committed					Non IRP
	Coal (PF, FBC, imports, own build)	Nuclear	Import hydro	Gas – CCGT	Peak – OCGT[1]	Wind	CSP	Solar PV	Coal	Other	DoE Peaker	Wind[2]	Other renewables	Co-generation
	MW													
2010	0	0	0	0	0	0	0	0	380	260	0	0	0	0
2011	0	0	0	0	0	0	0	0	679	130	0	0	0	0
2012	0	0	0	0	0	0	0	300	303	0	0	400	100	0
2013	0	0	0	0	0	0	0	300	823	333	1 020	400	25	0
2014	500	0	0	0	0	400	0	300	722	999	0	0	100	0
2015	500	0	0	0	0	400	0	300	1 444	0	0	0	100	200
2016	0	0	0	0	0	400	100	300	722	0	0	0	0	200
2017	0	0	0	0	0	400	100	300	2 168	0	0	0	0	200
2018	0	0	0	0	0	400	100	300	723	0	0	0	0	200
2019	250	0	0	237	0	400	100	300	1 446	0	0	0	0	0
2020	250	0	0	237	0	400	100	300	723	0	0	0	0	0
2021	250	0	0	237	0	400	100	300	0	0	0	0	0	0
2022	250	0	1 143	0	805	400	100	300	0	0	0	0	0	0
2023	250	1 600	1 183	0	805	400	100	300	0	0	0	0	0	0
2024	250	1 600	283	0	0	800	100	300	0	0	0	0	0	0
2025	250	1 600	0	0	805	1 600	100	1 000	0	0	0	0	0	0
2026	1 000	1 600	0	0	0	400	0	500	0	0	0	0	0	0
2027	250	0	0	0	0	1 600	0	500	0	0	0	0	0	0
2028	1 000	1 600	0	474	690	0	0	500	0	0	0	0	0	0
2029	250	1 600	0	237	805	0	0	1 000	0	0	0	0	0	0
2030	1 000	0	0	948	0	0	0	1 000	0	0	0	0	0	0
Total	6 250	9 600	2 609	2 370	3 910	8 400	1 000	8 400	10 133	1 722	1 020	800	325	800

1 OCGT is seen as natural gas in the determination

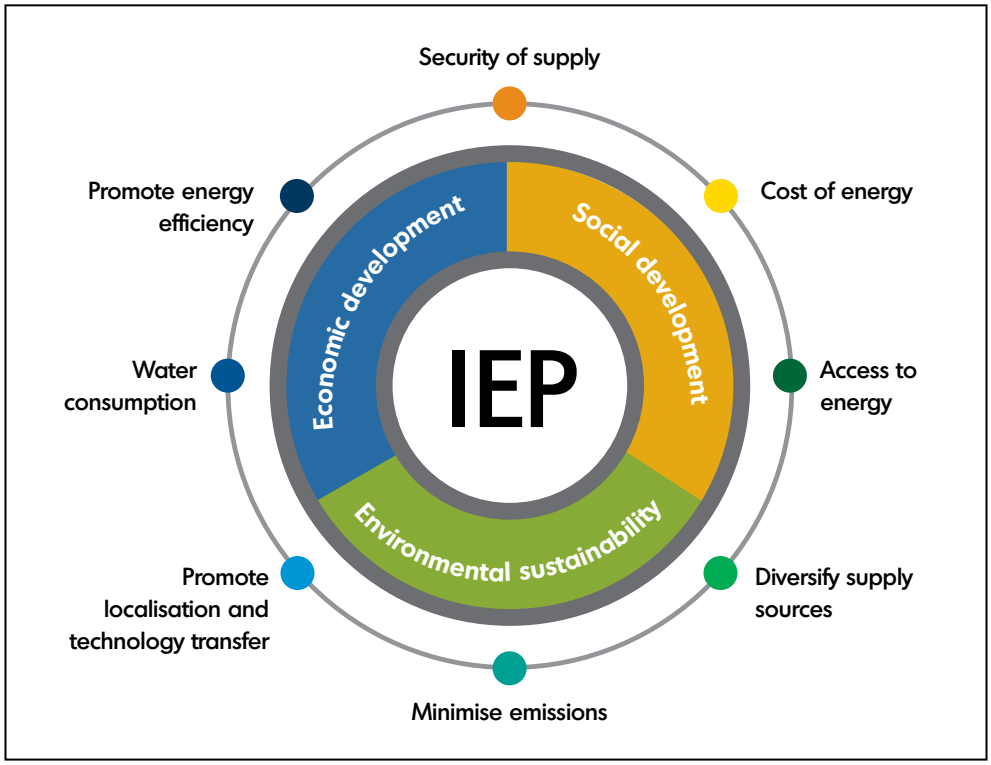
2 Includes Sere (100 MW)

FBC: fluidised bed combustion; IRP: Integrated Resource Plan; PF: pulverised fuel
CCGT: closed cycle gas turbine; OCGT: open cycle gas turbine.

Source: DEA (Department of Energy), *Integrated Resource Plan for Electricity (IRP) 2010–2030 Update Report*. Pretoria: DEA, November 2013, http://www.doe-irp.co.za/content/IRP2010_updatea.pdf, accessed 30 April 2014

In July 2013 the draft *Integrated Energy Planning Report*[51] was endorsed by the South African Cabinet and released for public comment. Through this updated policy document, instruments have been developed to give effect to renewable energy legislation and policy objectives. The plan affirms South Africa's continued reliance on coal, but also uses modelling to forecast which energy sources can be used most effectively to meet demand. The plan advocates diversification of energy sources, including renewables and fuel switching to improve energy efficiency.

Figure 4: Draft 2012 *Integrated Energy Plan (IEP) Report*



Source: Ramuedzisi T, 'Energy planning, Department of Energy overview of the Draft 2012, *Integrated Energy Planning Report*', lecture by the Chief Director: Energy. Johannesburg: South African National Energy Association, 11 February 2014, http://www.sanea.org.za/CalendarOfEvents/2014/SANEALecturesJHB/Feb11/TshilidziRamuedzisi-DeptOfEnergy.pdf, accessed 12 May 2014

In 2011 the government introduced the Green Economy Accord, a plan to partner with the private sector and public organisations to create 300 000 jobs by developing a green economy.[52] In this agreement government vowed to create an enabling policy environment to stimulate green growth, and to provide financial and institutional support to promote green industrial development.

The New Growth Path (NGP) of 2010; the updated Industrial Policy Action Plan II (IPAP2) of 2010 and the NDP: Vision 2030 (2011) all consider how renewable energy can benefit the country, particularly in terms of job creation. The NGP anticipates green economy jobs will principally be in natural resources management in the short term, with

renewable energy jobs being developed in the medium to long term. IPAP2 places 'special emphasis' on green industries, particularly manufacturing of components for the 17,8 GW renewable energy generation programme, and the production of solar water heaters and components. The NDP describes the transition to an environmentally sustainable carbon economy, while providing the strategic context for policies and planning instruments that promote a low-carbon economy, such as IRP in the electricity sector and the measures proposed for pricing carbon. However, the unease between climate action and South Africa's industrial commitment to sectors such as manufacturing, mining and beneficiation remains unresolved.

Draft Independent System and Market Operator (ISMO) Bill

The ISMO Bill was introduced in the National Assembly in March 2012, with the intention to create an electricity wholesaler that would be independent from activities related to electricity generation, to avoid a conflict of interest and thereby to ensure the equal treatment of all generators.[53]

Steyn[54] argues that there is a lack of clarity concerning whether the ISMO will be an exclusive central purchase, or whether licence recipients for generation may be exempted from selling to ISMO (implying a degree of competition and potentially further efficiencies). In addition, there are questions over whether the ISMO would own or simply operate the transmission grid. If the grid becomes the ISMO's asset, the potential for generation and supply competition between Eskom and independent power producers (IPPs) would be profound.

The NIP adopted by the South African government in 2012 commits $77.7 billion (ZAR 827 billion) to upgrading and expanding infrastructure in the transport, power, water and sanitation networks, and health and education sectors. On 30 May 2014 the Infrastructure Development Act 23 of 2014 was signed into law.

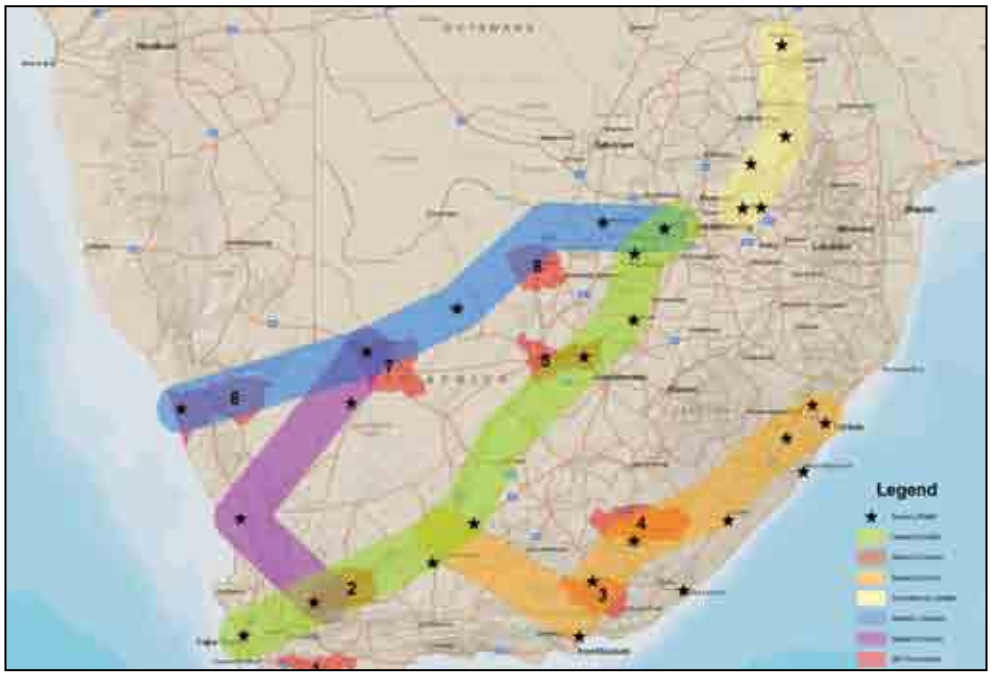
In an examination of the Bill that framed this legislation, Giordano[55] expresses disappointment that the opportunity to integrate green infrastructure principles into national planning was missed. Especially with the multilevel governmental approach (ie, national, provincial and local) initiated through the Presidential Infrastructure Coordinating Commission, the 18 strategic infrastructure projects through the NIP have transformative potential and job creation value. The author calls for bolder and more innovative moves, for instance, 'green budgeting, or the inclusion of green criteria into the public funding allocation process'.[56] However, more basic recommendations include expanding strategic environmental assessments (SEAs) to the sub-national level; finding agreement on what constitutes 'green infrastructure', and information sharing on how to interact in more sustainable ways with resources and the environment.

The Council for Scientific and Industrial Research (CSIR) has developed an SEA process[57] aimed at integrating environmental, economic and social factors to identify geographical areas (renewable energy development zones) where, in the medium to long term, wind and solar PV development will have the lowest possible impact on the environment, while yielding the highest possible social and economic benefit to the country.

Box 3: Council for Scientific and Industrial Research (CSIR) Strategic Environmental Assessment

- Vision for the SEA: Strategic electrical grid infrastructure is expanded in an environmentally responsible and efficient manner that responds effectively to the country's economic and social development needs.
- Key objectives include
  - › identifying electrical grid expansion corridors based on future energy supply and demand requirements, environmental sensitivities, and social and economic development priorities;
  - › streamlining the environmental authorisation process by pre-assessing environmental sensitivities to avoid fatal flaws and focus on the site-specific level of assessment; and
  - › reducing cost and timeframes for electrical grid infrastructure connection and expansion.
- Project partners include the DEA, Eskom and the South African National Biodiversity Institute. Additional lead stakeholders include industry; Treasury; DoE; Department of Agriculture, Forestry and Fisheries; the Square Kilometre Array; South African National Defence Force; provincial governments; and non-governmental organisations.

Figure 5: Corridors and focus areas for strategic environmental assessment



Source: CSIR (Council for Scientific and Industrial Research), 'Strategic environmental assessment for the rollout of wind and solar PV energy in South Africa'. Stellenbosch: CSIR http://www.csir.co.za/nationalwindsolarsea/images/2_Transmission%20Corridors_2.jpg, accessed 20 June 2014

RENEWABLE ENERGY: SET FOR TRANSITION?

According to the *Renewables Global Status Report 2014*,[58] the number of emerging markets and developing economies with policies in place to support renewable energy has increased from 15 in 2005 to 95 in early 2014. In 2013 an estimated 6.5 million people worldwide worked directly or indirectly in the renewable energy sector.[59]

The overall cost globally of transitioning the generation of electricity sector to one based on renewables is estimated at $100 trillion. This is an impossible investment obligation for governments worldwide, especially in the light of budgetary austerity after the global economic recession. Private sector capital is therefore required for the large-scale deployment of renewables. However, in this new and risky sector the private sector must receive sufficient motivation from governments through enabling legislation and a conducive regulatory environment.

South Africa's IRP 2010–2030 set a target of 18 800 MW: 9 200 MW allocated to wind energy; 8 400 MW to solar PV energy; and 1 200 MW to CSP of a total system capacity of 90 GW. This would be an increase from the current 1% up to 20%. The Energy Ministry has allocated 3 725 MW instead of the 1 025 MW that was outlined in the IRP. To date, the Renewable Bid Programme has contracted 2 470 MW of renewable capacity.

South Africa's energy regulator first explored the use of renewable energy feed-in tariffs (REFITs) in 2009 before turning to a competitive bidding process in 2011. In March 2011 the Renewable Energy Independent Power Producer Procurement Programme (REIPPP),[60] a public procurement programme, was introduced. Qualifying technologies include wind, solar PV, solar thermal, biomass solid, biogas, landfill gas and small hydro plants. An upper tariff level is established for each technology in the auctions. Winning bidders sign power purchase agreements guaranteed for 20 years.

The REIPP is aimed at substantially increasing renewable energy with a two-part bidding process. The difference between this new policy and the REFIT is that instead of bidding on projects based on fixed tariffs, this competitive bidding approach will evaluate investors on bidding price and ability to meet qualification criteria. These criteria are environment, land, commercial and legal, economic development, financial, and technical. The economic development requirements are complex, incorporating 17 sets of minimum thresholds and targets. For wind projects, for example, at least 12% of the project company shares had to be held by black South Africans and another 3% by local communities, and at least 1% of project revenues had to go to socioeconomic contributions. The minimum threshold for local content was set at 25%, with a target of 45% being encouraged.[61]

The REIPP allows a minimum 1 MW of energy capacity and the project has to be connected to the grid. Direct sales to municipalities are prohibited. The non-refundable application fee of $1,410 (ZAR 15,000) in addition to more requirements and paperwork and protracted power purchase agreement (PPA) negotiations is noted to discourage smaller, community-led projects from participating in the process. However, operators have found the tariffs to be attractive and bidding has been heavily over-subscribed.[62] The energy ministry, assisted by the National Treasury, decide the pre-set tariff pricing system – and not NERSA, which had been responsible for determine pricing in the REFIT system. The ministry and Treasury conduct the procurement process.

Table 3: Economic development thresholds and targets for South Africa's Renewable Energy Independent Power Producer Procurement Programme – Wind

Factor and criteria	Threshold (%)	Target (%)
Job creation		
South African-based employees who are citizens	50	80
South African-based employees who are black citizens	30	50
Skilled employees who are black citizens	18	30
South African-based employees who are citizens from local communities	12	20
Local content		
Value of local content spending	25	45
Ownership		
Shareholding by black people in the project company	12	30
Shareholding by black people in the contractor responsible for construction	8	20
Shareholding by black people in operations contractor	8	20
Shareholding by local communities in the project company	3	5
Management control		
Black top management	n.a.	40
Preferential procurement		
Broad-based black economic empowerment (BBBEE) procurement spending	n.a.	60
Procurement from small enterprises	n.a.	10
Procurement from women-owned vendors	n.a.	5
Enterprise development		
Enterprise development contributions	n.a.	0.6
Adjusted enterprise development contributions	n.a.	0.6
Socio-economic development		
Socio-economic development contributions	1.0	1.5
Adjusted socio-economic development contributions	1.0	1.5

Note: – n.a. not applicable (no threshold set)

Source: Eberhard A, 'Feed-In Tariffs or Auctions? Viewpoint', Public Policy for the Private Sector. Note 338. Washington, DC: World Bank, April 2013

The DoE's REIPPP has been particularly successful. In the three bidding windows to date, the government has approved 64 schemes – mainly solar and wind – costing more than ZAR 100 billion in total, which will potentially add almost 4 000 MW to the power mix.[63]

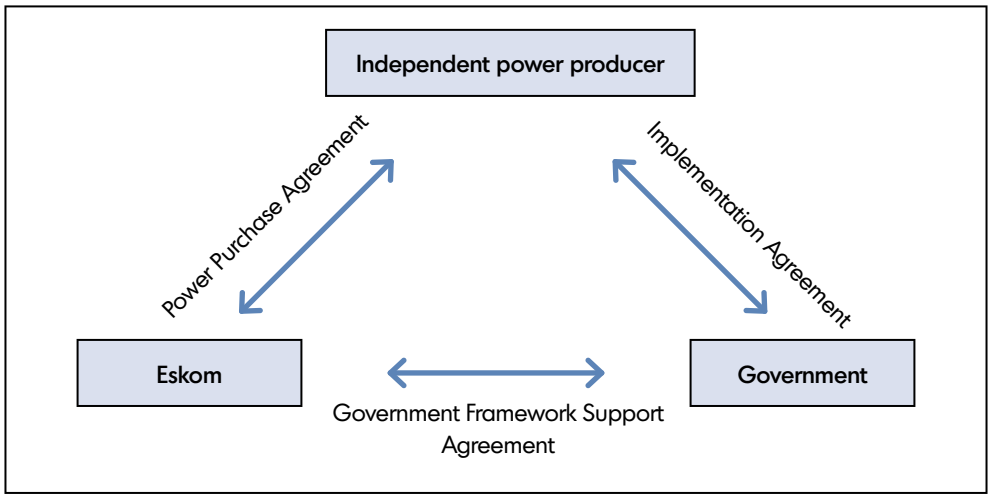
The procurement document provided for the procurement of 3 725 MW in five rounds, subject to the availability of capacity:

- Following the ministerial determination in December 2012, it was agreed that a further 3 200 MW of renewables generation capacity would be procured.
- An additional allocation of 308 MW was made available for bidding in Bid Window 3 (CSP 200 MW, biomass 47.5 MW and small hydro 60 MW)

The bid process[64] entailed the following:

- Bid Window 1: Entered into 28 agreements on 5 November 2012.
- Bid Window 2: Entered into 19 agreements on 9 May 2013.
- Bid Window 3:
  - Received 93 bids on 19 August 2013;
  - The bids amount to 6 023 MW, while the available MW for allocation was 1 473 MW; and
  - Bid prices were very competitive.
- Bid window 4: Closes in August 2014 for an additional 1 000 MW.

Figure 6: Renewable energy independent power producer – Contracting arrangement



Source: DEA, 'Renewable Energy IPP Bid Window 3 Preferred Bidders' Announcement'. Pretoria: DEA, 4 November 2013, http://www.energy.gov.za/IPP/List-of-IPP-Preferred-Bidders-Window-three-04Nov2013.pdf, accessed 14 May 2014

ECONOMIC INCENTIVES FOR RENEWABLE ENERGY

According to Felix Mormann,[65] attempts to promote renewable energy or to assess the effectiveness of promotional efforts require a deep understanding of the obstacles to a timely transition towards renewables. Only through the identification and understanding of the obstacles can appropriate policy instruments – such as economic incentives – be

put in place to overcome them. This includes incentives for big players in the fossil fuel industries to give up their well-established infrastructure and market positions for an increased share in the renewables market

Using the definition from the World Bank's Investment Climate Unit, economic incentives can broadly be of two types: (1) regulatory or (2) financial. Regulatory incentives are applied by, for example, guaranteeing property rights, correcting for external economic factors, preventing abuse by monopolies or easing or exempting from certain regulatory requirements. Financial incentives are subsidies, grants or financial administrative assistance provided to investors. The two incentive types can, in turn, be either fiscal (with a positive tax effect) or non-fiscal (which could include subsidies, preferential loans, investor facilitation and after-investment care facilities, and increased, more positive, government–business interaction).[66]

Two of the better known instruments to encourage renewables deployment are (1) feed-in tariffs and (2) competitive bidding on energy supply blocks. Germany has consistently applied the feed-in tariff, which is considered a production incentive. The electricity distributor is obliged by the German Renewable Energy Sources Act to buy electricity from every grid-connected renewable energy generator at a certain minimum feed-in tariff. Sources of funding to enable the distributor to buy at the grid-feeder tariff are direct subsidies and/or a cross-subsidy from the electricity consumer via the price paid. A 'set-aside' is a block of energy supply that is earmarked by law for renewable energy capacity. Potential renewable energy generators tender to provide the block of renewable energy supply. Winning projects receive financial support, for instance, a subsidy per kWh or a guaranteed fixed electricity tariff.

South Africa attempted the feed-in tariff, but abandoned this method in favour of competitive bidding. While there seems to be strong commitment to rolling out renewable energy generation, there is broad disappointment at the slow rate of implementation of renewable energy projects and the significant threat that South Africa will continue along its path of increasingly using coal technologies.

This is, in part, as a result of the challenges highlighted by stakeholders in the cross-section of sectors; for instance, the following:

- The policy framework, while moving in a positive direction, is not sufficiently co-ordinated across affected departments (ie, DoE, DEA, Department of Trade and Industry (dti), and National Treasury), as well as across different levels of government.
- Delays in environmental impact assessments can take up to 18 months.
- Reviews often exceed their scope and become over-prescriptive.
- Efforts at bringing communities into ownership structures are commendable, but the localisation component requirements seem in instances superficial and unsustainable.

The primary impetus behind employing incentives in the renewable energy environment – and the green economy more generally – is to address the lack of maturity within the sector in South Africa and the imbalances that have resulted from the economic dependence on coal. In comparison with Eskom's model of generation, the relatively high capital cost of most renewable energy technologies makes them commercially uncompetitive in the short to medium term.

An appropriate enabling environment through fiscal, financial and regulatory instruments is needed to encourage increased utilisation of these technologies. This includes government support to initiate renewable market share and non-discriminatory open access to the national electricity grid and wheeling arrangements and related energy infrastructure.[67]

Box 4: Financial incentives

According to Eskom's website,[68] Eskom's energy efficiency incentives, collectively known as the 'Integrated Demand Management (IDM) Programme', have been put on hold due to financial constraints experienced by the energy utility.

When operational, the IDM programme will consist of three funding models, namely (1) the Energy Service Company (ESCo) Programme, (2) the Standard Offer Programme and (3) the Standard Product Programme. Each programme will have its own structure, requirements and funding model linkable to the requirements and status of different businesses.

The ESCo Programme encompasses all energy-efficient projects with incentives linked to the energy-saving and cost of implementation of the energy reduction project. In this programme, a monitoring and verification plan has to be developed specifically for the project, and be used in ongoing monitoring to ensure that the entity meets the performance contract with Eskom.

The Standard Offer Programme is a scheme through which Eskom buys back energy savings from the entity over a period of three years. The energy savings are the collective energy savings over three years for an energy-efficiency project which is then purchased by Eskom at a rate of between $0.04/kWh and $0.12/kWh (ZAR 0.42/kWh and ZAR 1.20/kWh) depending on the technology chosen. The entity can expect 70% of the total energy savings after the implementation and verification of energy savings, and 10% per year for the three years following the implementation of the project.

The Standard Product Programme focuses on pre-approved rebates for predetermined energy savings achieved through specified technologies and the efficient replacement of, for example, lighting, shower heads and industrial pumps. The target is small to medium projects of less than 250 kW savings. The market focus is on commercial standard value per rebated item, scaled to 85% of Standard Offer Programme Rebate capped at $176,250 (ZAR 1,875,000).

The Green Energy Efficiency Fund (GEEF) administered by the Industrial Development Corporation (IDC) supports the introduction of energy efficiency and self-use renewable energy technologies, and will ultimately continue contributing to global climate protection while supporting South Africa's economic development and growth. To encourage energy

efficiency and renewable energy investments, the IDC and the German Development Bank, (KFW), have partnered, under the framework of the South African–German Financial Co-operation, and established a $47 million (ZAR 500 million) facility for energy efficiency and small-scale renewable energy projects.

The IDC will increase awareness of the need for energy efficiency among enterprises through the promotion of the GEEF, which supports the IDC's alignment to IPAP2, and the NGP, with specific focus on growing the green economy.

The benefits of this investment include, but are not limited to, the following:

- technical support available for energy assessments based on the size and complexity of the proposed project;
- investment risk reduction through energy efficiency validation checks;
- modernisation of the industrial equipment used and the use of energy efficient technologies will result in reduced energy and other costs;
- improved product quality and production capacity while increasing the company's profitability;
- improved company image due to contributions to carbon footprint reduction and South Africa's sustainable development goals;
- lower vulnerability to increasing energy prices;
- increased company value; and
- providing access to local and international experts for:
  - conducting energy assessments and audits to propose sustainable energy; solutions and support the preparation of investment project proposals;
  - calculating the economic and financial benefits of the proposed investment; and
  - supporting the selection of eligible equipment and enhanced performance technologies.[69]

Box 5: Gro-E Scheme

The IDC is investing $0.95 billion (ZAR 10 billion) over five years through its Gro-E Scheme. The aim is to offer financial support to start-up businesses (or expansions), including funding for buildings, equipment and working capital where the businesses show that they can create jobs, where the maximum cost per job does not exceed $47,000 (ZAR 500,000) relative to the total funding required. In addition, broad-based black economic empowerment is emphasised.

Businesses are expected to operate in sectors supported by the IDC, including green industries, which include renewable energy, energy efficiency, pollution mitigation, waste management and recycling, and biofuels.

Other industries that can benefit from the incentive are the following:

- Agricultural value chain, including agro-processing;
- Manufacturing, focusing on advanced manufacturing; automotive, components,

medium and heavy commercial vehicles manufacturing; clothing textiles, footwear and leather; forestry, paper and pulp, and furniture; metals fabrication, capital and transport equipment; pharmaceuticals; plastics; and chemicals;
- Mining value chain, including downstream mineral beneficiation, mining and mining technologies;
- Tourism and high-level services, which include business process services and tourism;
- Media and motion pictures, which has to do with media pictures production, the media value chain of broadcasting (ie, radio and television), media expansion, including new media, music value chain, and film production and animation; and
- The knowledge economy, health care, information and communications technology and biotechnology.

The scheme works by funding businesses at prime less 3% for loans and the real after-tax internal rate of return of 5% for equity financing. A minimum of $94,000 (ZAR 1 million) with a maximum of $94 million (ZAR 1 billion) per project will be allowed. The funding is available over five years or until the scheme is exhausted.

Renewable Energy Finance Subsidy Office (REFSO)

The DoE has established the Renewable Energy Finance and Subsidy Office (REFSO), whose mandate includes managing renewable energy subsidies, and offering advice to developers and other stakeholders on renewable energy finance and subsidies. This includes information on the size of awards, eligibility, procedural requirements and opportunities for accessing finance from other sources.

Since the establishment of REFSO, six projects with a total installed capacity of 23.9 MW have been subsidised. Three of these projects are (1) small-scale hydro, biogas-to-electricity project, (2) wind energy project and (3) landfill gas-to-electricity project. REFSO finance options include grants for feasibility studies, short-term finance, long-term finance, export credits and soft loans, equity or loans, and purchase of carbon emission reduction credits.

Box 6: Manufacturing competitiveness enhancement programme

This programme is aimed at ensuring the relevance of the South African manufacturing industry on the international playing field and helping to protect South African jobs against the effects of an influx of imports. A major component of this grant programme is an allowance for expenditure on green technology, and resource and efficiency improvement. The government has allocated $0.54 billion (ZAR 5.8 billion) to the programme over the period 2012–2015. The grant is calculated according to the manufacturing value add of business, which can then be used on a cost-sharing basis where the dti pays between 50% and 30% of the costs of the category, Green Technology and Resource and Efficiency Improvement.

The Critical Infrastructure Programme and the Enterprise Investment Programme are both linked to investment projects being allowed financial assistance from the government. The REFSO has also been established to assist in finance provision for renewable projects, allowing up to $94,000 (ZAR 1 million) grants for every megawatt installed, with six projects being financed in 2010 and 24 MW being subsidised.

Box 7: Department of trade and industry incentive schemes for electric vehicles

The Minister of the dti, Rob Davies, launched the Road Map for the Development of Electric Vehicles, and the incentive that has been under consideration by the dti to stimulate demand for these vehicles.[70] Davies said that by providing investment support through the Automotive Investment Scheme and the Automotive Production and Development Programme, the dti will offer a 35% investment incentive. Furthermore, the dti will reduce the qualifying investment incentive of 50 000 units produced annually to 5 000 units for electric vehicles.

Support Programme for Industrial Innovation

The dti's Support Programme for Industrial Innovation is not specifically aimed at renewable energy or green economy technologies. However, given the rapid technological diffusion from other parts of the world and applied in a local context, there is significant scope for the application of this variable annual budget incentive fund to finance the development of new green technologies for the South African economy.

Box 8: Regulatory incentives

Under the current legislation, Section 12B of the Income Tax Act 58 of 1962, signed into law in September 2009, allows businesses to depreciate investments in renewable energy and biofuel production at a rate of 50:30:20 by allowing *accelerated depreciation* on these assets. Thus, the South African Revenue Service is giving cash-flow advantage to businesses, which should assist them with investment in renewable energy projects. The amendments to the Income Tax Act sections 11 and 12B now propose that support structures related to the *investments in renewable energy and biofuel production should be depreciated at the same rate as the plant and machinery depreciation rate* detailed above. The reasoning behind the amendment is to allow businesses that implement the renewable project to receive a benefit for the majority of the costs of the projects, not only for the physical wind turbines, solar PV panels and similar energy generation equipment. This amendment will make it easier for businesses to become self-sustainable in the long run.

South African businesses that receive benefits from CDMs are exempt from tax on revenue derived from such benefits, be it in the form of income tax or capital gains tax. This

benefit is described in section 12K of the South African Income Tax Act. Because it takes between two and five years for a CDM project to generate revenue, this will be the first time that the entity will be able to draw a benefit from this tax concession. CDM projects often take a significant amount of time and large amounts of capital to implement. By allowing businesses to take advantage of a tax break on the income derived from these types of projects, the government is encouraging investment in research and development.

Box 9: Renewable energy market transformation (REMT)

The World Bank and Global Environmental Fund have funded the Renewable Energy Market Transformation (REMT) project,[71] with contributions from the DoE. The programme is hosted by the Development Bank of Southern Africa, and is aimed at removing and reducing the implementation costs of renewable energy technologies. REMT provided significant input into policy and regulatory guidance to the government of South Africa on the review of the initial REFIT procurement and related standardised PPA, socio-economic study related to the implementation of the IRP2010, as well as policy and regulatory framework support in the development of the National Solar Water Heating Framework and draft *Renewable Energy White Paper* and the ISMO Bill. REMT continues to support DoE and the government in implementing the Renewable Energy IPP, which has made a strong start towards procuring over 3 625 MW of renewable energy capacity, with strong response, especially in the category of CSP and Wind.[72]

Tradable Renewable Energy Certification

Tradable Renewable Energy Certification is an electronic record that verifies the origin of energy by the registered renewable energy entity; it refers to green certification or green tags.[73] It is another revenue stream for renewable energy IPPs. Certificates can be traded worldwide and separately from the electricity grid infrastructure.

Box 10: Biofuel industrial strategy

In December 2005 the South African Cabinet approved the development of an industrial strategy targeted at creating jobs in the energy crops and biofuels value chain.[74] This was viewed as an opportunity to bridge the gap between the first and the second economy. Cabinet also authorised the establishment of a biofuels task team comprising relevant national departments and state entities to develop the industrial strategy. In December 2006 Cabinet approved a draft Biofuels Industry Strategy for public consultation. The consultation involved workshops and meetings at both national and provincial level, and consultations with organised industry, farmers, communities, NGOs and provincial government departments. A short-term focus was recommended (five-year pilot) to achieve a 2% penetration level of biofuels in the national liquid fuel supply, or 400 million litres a year. The target has been revised down from the 4.5% target that was initially proposed in the draft strategy document.

The following crops are proposed for the production of biofuels in South Africa: bioethanol, sugar cane and sugar beet, and for biodiesel sunflower, canola and soya beans. The exclusion of other crops and plants such as maize and Jatropha is based on food security concerns.[75]

Demand Side Management Subsidy Solar Water Heater Programme

Eskom, together with the government, has developed a programme for the mass rollout of solar water heaters over the next three years. The current cost of a solar water heater unit is perceived to be unaffordable and prohibitive (the estimated cost is between ZAR 7,000 ($658) and ZAR 20,000 ($1,880). To eliminate these barriers, Eskom will be providing a subsidy of 50%. Potential savings of the programme is 650 MW.

Box 11: Northern Cape: Solar corridor and potential special economic zone

The Northern Cape Province yields among the world's highest rates of direct normal irradiation and has become the nucleus of South Africa's solar energy industry. The province hosts the DoE's proposed 5 000 MW solar park in the Northern Cape solar corridor. It is also host to South Africa's first three CSP plants, with a number of other solar energy plants under development.

In order to derive maximum benefit from solar developments, the Northern Cape is working with the dti to develop the area around Upington as a special economic zone (SEZ) that will offer incentives to support local manufacturing. A 400 ha site has been identified at the airport. SEZs are geographically designated areas of a country set aside for targeted industrial or economic activities that are supported through special arrangements and measures that are often available to the rest of the country.

With the remarkable interest from foreign-owned solar companies, in particular from Spain and Germany, economic development in Upington has been significant and rapid. As an SEZ, the region will enjoy the following benefits:

- A 15% corporate income tax rate for businesses;
- An employment incentive allowing for a tax deduction for employment of workers;
- An accelerated depreciation allowance (capital allowance of 10%) for the erection or improvement of buildings in these areas; and
- Value-added tax and custom relief.

Upington Airport is a key resource and has been granted international status with regular flights, especially from Spain and Germany. The airport infrastructure and the strategically advantageous location make it a viable stopover en route to the African continent. Apart

from accommodating the foreign investment relocation of assets and staff to foreign-owned solar companies, Upington is also increasingly used for testing German automobiles because of the flat, open space and extreme temperatures. The Kgalagadi Transfrontier Park, an area of over 3,6 million hectares, is 250 km from Upington, and borders both Namibia and Botswana.

Box 12: Foreign direct investment: Spanish-owned company, Abengoa SA, in Upington

This foreign direct investment (FDI) project consists of the construction and operation of two greenfield CSP projects near the towns of Upington and Pofadder, in South Africa's Northern Cape Province, by Abengoa Solar, through its affiliates Abengoa Solar South Africa (Pty) Limited and Son Revieren (Pty) Limited, in partnership with the IDC. Abengoa Solar's parent company, Abengoa SA (Abengoa), is a leading developer of renewable energy projects.[76]

The 100 MW plant, !KaXu Solar One or Pofadder Solar Thermal Plant, utilises parabolic trough (PT) CSP technology. PT technology involves a field of pivoting concave mirrors tracking the sun, and concentrating the reflected sunlight onto a closed-circuit network of piping that contains synthetic oil which is heated and rounds through a generator, creating steam to drive a 100 MW net capacity turbine. The electricity generated is transmitted through a high-voltage substation for dispatch to the grid. The plant design includes a molten salt thermal energy storage (TES) system that allows for extended electricity generation of up to 2.5 hours for controlled dispatch during cloud cover or to meet evening electricity demand.

The 50 MW plant, !Khi Solar One or Upington Solar Thermal Plant, utilises a central receiver or solar power tower technology. The tower technology captures solar radiation in a field of dual axis mirrors that track the sun, and concentrates the reflected sunlight onto receiving steam generators located on top of a single 200 m tower. Super-heated steam is piped to a 50 MW net capacity turbine that generates electricity transmitted through a high-voltage substation to the grid. The plant design includes a high-pressure steam storage system which, like the molten salt TES of the !KaXu plant, allows for controlled dispatch during cloud cover or to meet evening electricity demand.

The International Finance Corporation, which is a financing partner for the two projects, has completed an environmental and social assessment on the projects. This review was last updated on 8 June 2014. The review found that for each of the major environmental impacts, including environmental and ecological impacts, local employment benefits during construction and operation, and water and land use were found to comply with requirements set by the DEA.[77]

Box 13: Foreign direct investment: wind power company – Irish Mainstream Renewable Power in the Northern Cape Province

Mainstream Renewable Power leads the consortium that was awarded preferred bidder status under the third round of the DoE's REIPPPP in October 2013 for three large-scale wind energy projects, in the Northern Cape, with a combined generation capacity of 360 MW.[78] The equity members of the consortium include Thebe Investment Corporation; the Infrastructural, Developmental and Environmental Assets Managed Fund, managed by Old Mutual Investment Group; Futuregrowth Asset Management; Genesis Eco-Energy in partnership with Lereko Metier Sustainable Capital; Mainstream Renewable Power; and a local community trust.

The Mainstream Renewable Power group currently has a project portfolio comprising over 19 000 MW in Ireland, the United Kingdom, Germany, South Africa, Chile, the US and Canada.

The Northern Cape Province wind farms awarded were the 140 MW Khobab wind farm and the 140 MW Loeriesfontein 2 wind farm, both in the district municipality of Namakwa; and the 80 MW Noupoort wind farm, in the local municipality of Umsobomvu, all in the Northern Cape Province.

Source: Barradas S, 'Mainstream Renewable Power wind projects, Northern Cape, South Africa. Engineering News. Johannesburg: Creamer Media, 14 February 2014, http://www.engineeringnews.co.za/article/mainstream-renewable-power-wind-projects-south-africa-2014-02-14, accessed 30 May 2014

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Both photos: Khi Solar One, Upington – Northern Cape

- Ownership: 51% Abengoa Solar South Africa (Pty) Ltd, 29% Industrial Development Corporation (IDC), 20% a community trust backed by broad-based black economic empowerment (BBBEE)
- Backed by IFC, EIB, DBSA, Clean Technology Fund, IDC, Proparco, FMO
- Rio Glass – Saudi investment $4.5 million (supplier): 30–40 local jobs

Located approx. 20 km SW of Upington: Kai Garib Municipality, Northern Cape Province (just off the D3276 Lutzputs road)

- Brownfields site
- 600 ha permitted
- Eskom power line approx. 4 km south of site
- River 10 km south of site
- Capacity: 50 MW
- Steam storage capacity of 3 hours
- Approx. 4 500 heliostats with a collector surface area of approx. 580 000 m^2
- Plant scheduled for operation by end-June 2014, but delays likely

Total Abengoa Solar commitment across the !KaXu and Khi projects greater than ZAR 10 billion (approx. $1 billion)

- Ownership: 51% Abengoa, 20% Community Trust, 29% IDC
- Roughly 600 construction jobs over 24 months
- 35 permanent employees over 20-year operational phase
- 100 additional jobs due to services and supplies from the greater area
- Roughly 190 GWh annual production
- 183 000 tonnes reduction in CO_2 emissions

CONCLUSION

South Africa's history of low, stable electricity prices built on the basis of cheap coal production has left the industry with performance and efficiency levels far below average international standards. The South African minerals–energy complex has come about as a result of a heavily capital-intensive industry driven by extraction of resources – mining and limited mineral beneficiation – buttressed by low electricity prices. The country's dependence on coal has not only led to a high-carbon, fossil fuel-based economy, but the depletion of existing coal reserves has resulted in an ongoing energy crisis since 2008. Two new coal developments are expected to come online within the next 18 months. However, this is unlikely to eliminate the crisis as it will be insufficient for current energy needs and will be highly carbon intensive.

The widespread deployment of renewables – along with a change in mindset regarding the use of energy – is required to bring about a more efficient energy mix, with efforts to properly place the burden on the most inefficient or intensive users. Government should encourage further innovations and incentivise investments through appropriate interventions and policy instruments.

The South African government has undertaken various policy steps towards the implementation and use of green or renewable energies. The environmental assessment initiatives by its science councils, such as the CSIR, and co-investments through its development finance institutions, such as the IDC, are excellent examples. Unfortunately, efforts are not seen to be co-ordinated across government departments, nor integrated across different government – national, provincial and local – levels. In addition, the environmental impact assessments undertaken in advance of selection of renewables sites could be more focused on specific details for specific requirements. This is expected to shorten the environmental impact review process and bring better quality renewable projects online sooner.

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South African Institute of International Affairs
Jan Smuts House, East Campus, University of the Witwatersrand
PO Box 31596, Braamfontein 2017, Johannesburg, South Africa
Tel +27 (0)11 339-2021 • Fax +27 (0)11 339-2154
www.saiia.org.za • info@saiia.org.za

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