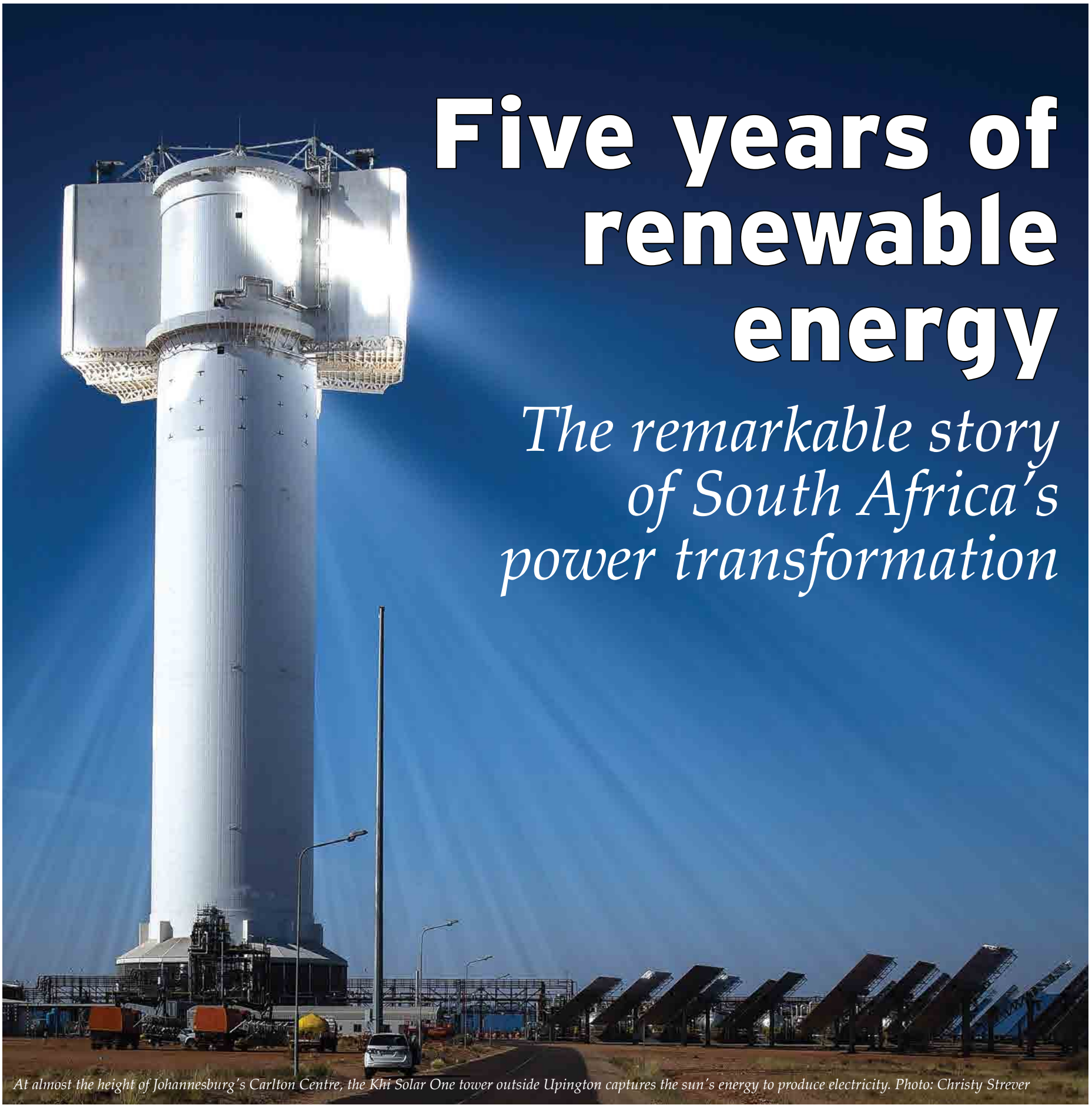
BusinessDay

Special Supplement
31 October 2016

# Five years of renewable energy

## *The remarkable story of South Africa's power transformation*



*At almost the height of Johannesburg's Carlton Centre, the Khi Solar One tower outside Upington captures the sun's energy to produce electricity. Photo: Christy Strever*

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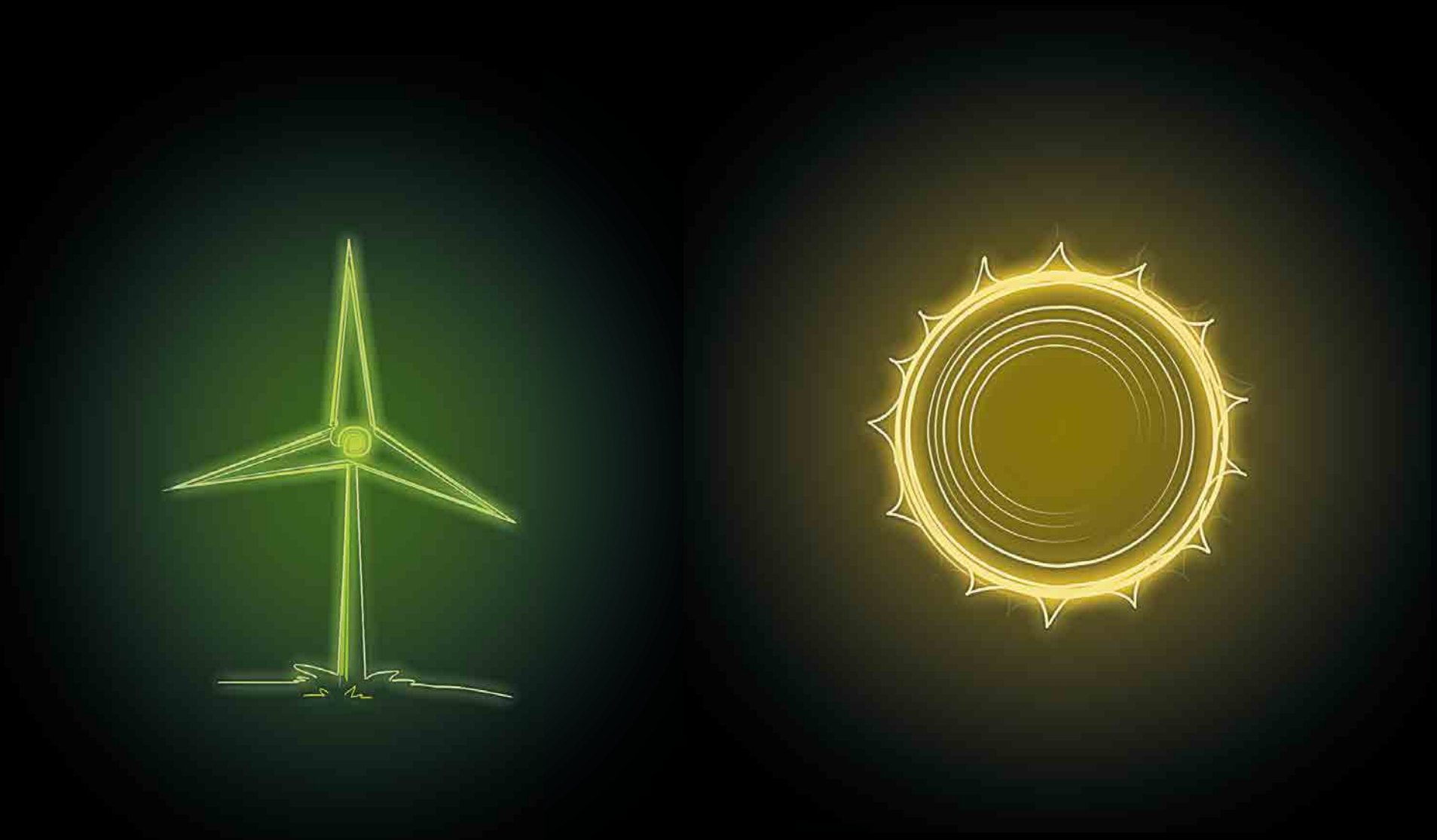

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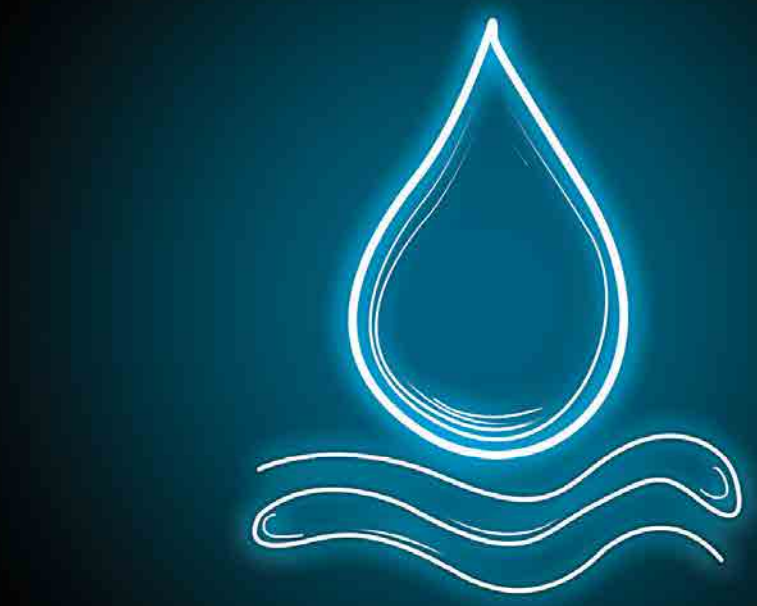

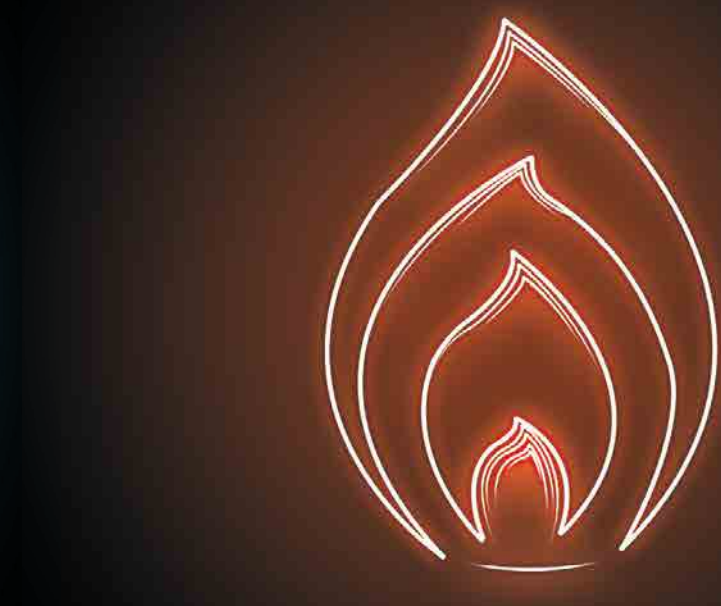

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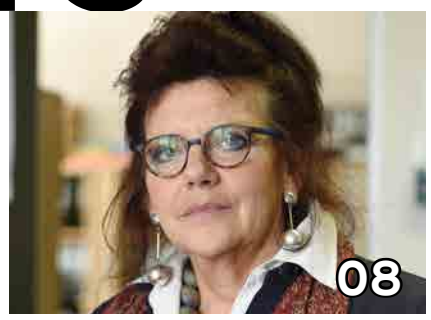
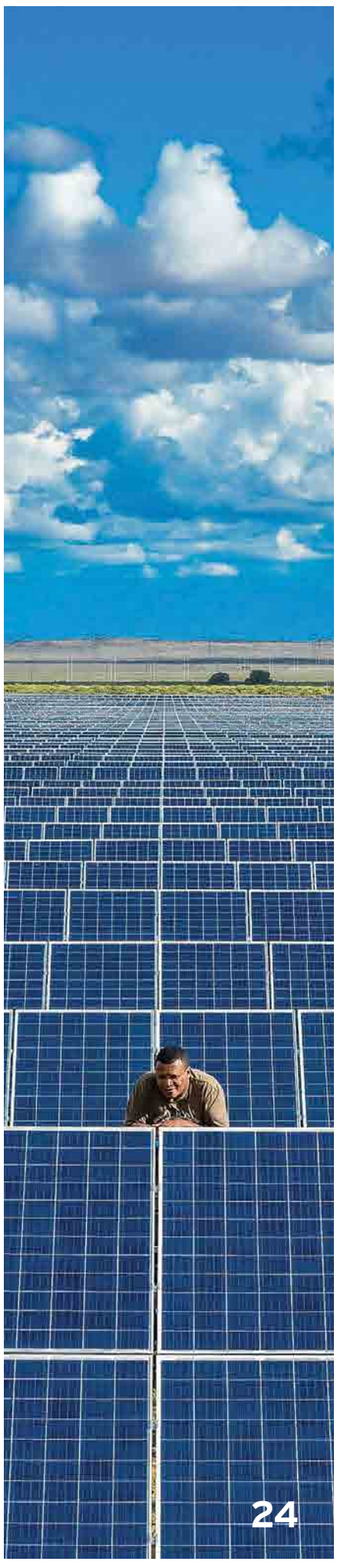
# CONTENTS










## NEWS AND VIEWS





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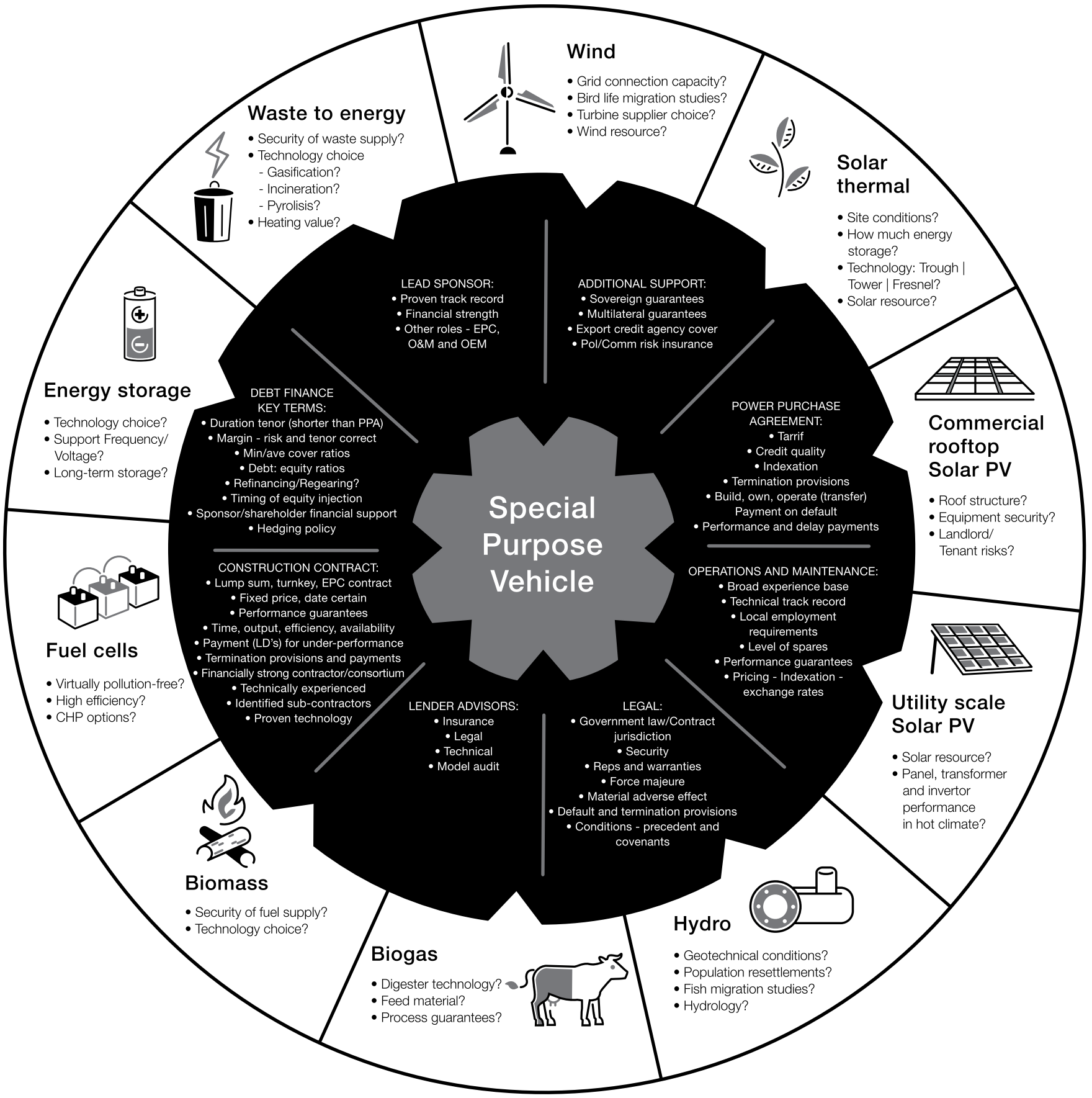


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Photo: Christy Strever

## Introduction

# THE STORY OF SOUTH AFRICA'S GLOBAL ENERGY COUP

*Stuart Theobald*

Imagine 200 hectares covered in photovoltaic solar panels. That's about 400 football fields, or 20 times the size of Zoo Lake park in Johannesburg. There's now not just a few, but 25 projects of that size or bigger already built or being built across South Africa, and many smaller ones.

Then there are the wind energy farms. Most wind turbines are around 100m high, the same height as London's Big Ben, with blades that each span more than 40m. There are more than 1,500 such windmills already erected or being erected across the country.

Then there are the spectacular concentrated solar plants that direct the sun's rays either on to a tube in a curved mirror, or towards a tall tower in the centre of a field of mirrors. One planned project, Redstone, will have a tower over 250m high – higher than the Carlton Centre in Johannesburg. There are also hydroelectric, biomass and landfill projects being constructed.

So far, R194bn has been invested by both the private and public sectors to make it happen, a large chunk of that has come in the form of foreign direct investment. That is six times what was invested in stadiums and other infrastructure for the 2010 Fifa World Cup soccer tournament in SA.

The scale of what has been achieved in South Africa's renewable energy programme is simply mind-blowing. But it is a story that has not really been told, least of all in South Africa itself. Most projects are in remote areas, hours away from any airport, making them difficult for journalists to access. This publication is an effort to change that, and to mark the five-year anniversary of the programme. The team behind it has criss-crossed South Africa, climbed into gyrocopters and other light aircraft to get decent camera angles and driven thousands of kilometres to see projects first-hand. It has not been easy, but we wanted to bring the magnitude of what has been achieved to Business Day's readership. It is a story of a remarkable infrastructure achievement of the government.

I first took note of the renewable energy independent power producer procurement programme (REIPPP, usually pronounced "reep") last year at a development finance conference in Luxembourg. A speaker from a European utility was gushing about what South Africa had achieved, calling it "the most successful green energy procurement programme ever".

The global excitement at what South Africa had done was palpable. This was something different. Here was a well thought through plan to deliver on the renewable energy objectives of the National Development Plan and South Africa's commitments to help fight climate change. And while so many infrastructure projects end up far over budget and behind schedule, this one had mostly delivered projects on time and on budget.

The international attention turned into emulation, as countries from Chile to the United Arab Emirates studied the South African process to implement IPP programmes in their own markets.

The revolutionary aspect of the South African approach was to change the way power producers are selected. Instead of publishing a single tariff that the government was willing to pay, it conducted auctions in which potential producers bid a certain price per megawatt they were willing to sell at.

The effect was to focus competitive pressures on the prices that producers charge and to limit risk by locking them into 20-year contracts.

The results have been dramatic. The government has conducted four main bidding rounds and in each one prices have plummeted. The first round in 2011 received an average price of R2.52/kWh, but by the fourth round that had fallen to just 82 cents.

Using an approach inspired by South Africa's, last month Abu Dhabi announced a new world record low price for a photovoltaic solar plant of 2.42 US cents/kWh, equivalent at the time to 34 South African cents. The new Medupi and Kusile coal-powered stations, when they come fully online, are forecast by various experts to cost between 100 and 120c/kWh.So successful has the approach been it is now being used for non-renewable IPPs too, with two coal projects recently announced and a process now being developed for gas-fired IPPs.

The world's development thinkers were eager to learn about the renewables programme, but it struck me how little South Africans themselves had heard about it. So the ambition grew to produce this publication. It has not always been easy – there is a kind of fearfulness in the government and the industry that publicity may not help the programme. Despite repeated requests, the Minister of Energy Tina Joemat-Pettersson did not agree to an interview. The fear may be that the programme might become the focus of jealous contestation as established interests in energy generation recognise the dramatic impact it is having on the future of the industry.

Indeed, as we were preparing this publication, Eskom raised various objections to the purchase agreements it is required to sign with independent producers in order to distribute the power they produce, an objection that has introduced damaging uncertainty into the programme. The key roleplayers, however, are optimistic that the success that has been demonstrated by the programme means it will be impossible to quash.

Another noteworthy feature of the programme is the economic development aspects of it. Firms bid to direct between 1% and 3% of their total top-line turnover towards community development projects. The result of this is going to be massive in those areas where there are projects. We expand on that on page 31.

Putting together this publication has been a matter of pride for the Intellidex team and our colleagues at Business Day. We have focused on telling the story of the REIPPP programme, both through the narrative and visually. We wanted to bring the scale of the programme directly to the public so we've relied extensively on photography. Had we had more time and resources we could have tripled or quadrupled the number of projects we profile in these pages, but what we present here covers the main technology types and gives a flavour for the epic scale of the programme.

We have been assisted by many people involved in the project who have been acknowledged elsewhere, but let me extend my personal thanks to them all.

Critical to the project has been the funders, including the IPP Office and the Development Bank of Southern Africa as main sponsors, and Nedbank. While they offered much advice, the sponsors had no part in the final content of this publication, which has been produced independently by the team. As always, I am interested to hear your thoughts and can be emailed on stheobald@intellidex.co.za. ■


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# A GRADUAL, SUDDEN MIRACLE

*This is the story of how South Africa produced an entirely new industry out of nothing, establishing itself as a world leader in renewable energy*

## *Stuart Theobald and Colin Anthony*

In Ernest Hemingway's *The Sun Also Rises,* Bill asked: "How did you go bankrupt?"

"Two ways," Mike said. "Gradually and then suddenly."

That is how the renewable energy independent power producers procurement (REIPPP) programme came about. Gradually and then suddenly.

Five years ago hopeful bidders pitched to be among the first independent power producers of renewable energy in South Africa on 4 November 2011. Hardly a month later, 28 winners were announced by then-energy minister Dipuo Peters at the 17th Congress of Parties (COP 17) conference in Durban. The request for proposals had only gone out to the market on 3 August.

"It is a story about people and their commitment and belief in what we were trying to do," says Karén Breytenbach, head of the IPP Office which oversaw the process. "Everyone was behind us – the whole government. It was an amazing experience."

When that first set of bids was received – 53 were submitted – it was the first time anything like it had been done. And there were plenty of lessons to learn. "The cut off time was about getting past the gate and being inside the delivery area by midday," says Maduna Ngobeni, the principle energy officer at the IPP Office. "Some were printing their documents still on the back of trucks. Some were there until 11pm." So the first change for subsequent bids was that documents had to be delivered within an hour of getting through the gate.

For one of the bidders, Obakeng Moloabi from Pele Green Energy, the experience was incredible. "We arrived at the tender submission venue at 11.58, with two minutes to spare. I broke all sorts of road rules. We had three cars with the boxes all in our cars with six copies of all the documents. It was the most exhilarating time that I can remember. I really treasure those memories. So much has changed now five years later, but in hindsight that was the watershed moment when things changed totally, for me as an individual, for us as a then-small company starting up, and also for the country, for the beginning of the liberalisation of a monopolised sector."

For the team assembled to assess the bids it was a very late night, another of many that had gone into the programme. "We worked through the night. We carried those big boxes of documents around ourselves," says Breytenbach. The bid documents consisted of 5,000 pages, and each came in six copies. The submission venue had itself been hastily assembled in a parking garage at Gallagher Estate outside Johannesburg. "It was underneath a building and had no lights, we had to put lights up. We put up dividers and cameras to monitor and record the whole process."

A strict security process ensured nothing was tampered with. One of the assessors, Pippa Reyburn, a director at legal firm Edward Nathan Sonnenbergs, says "The security was intense – you couldn't take anything in and we were body searched when going to the bathroom and when returning. We were working 12 to 14 hours a day, probably for three to four weeks like that."

The bids had to be assessed in just weeks in order to make sure the announcement could be made at COP 17. The assessment team had been drawn from the private sector – lawyers, accountants, technical experts and economic development consultants. "We decided the private sector would evaluate the bids but we also had a parallel evaluation process with our own team just to build competence," says Breytenbach.

The assessment teams were split into four workstreams: legal, financial, technical and economic development impact. Most streams had professionals from competing firms. They then went through each of the bids under the eye of cameras and microphones that recorded every detail of the process.

*"Everyone was behind us – the whole government. It was an amazing experience."*

*Karén Breytenbach, Head of the IPP Office*

A report with winning bidders had to be ready for Nelisiwe Magubane, the director-general of the Department of Energy (DoE), in a fortnight to make the COP 17 deadline. The final letters of appointment were signed the day before the big announcement. When Peters read the winners out to the audience in Durban, it was the first time she'd seen the list. For the winners, it triggered an ecstatic celebration.

At the same time an announcement was made of a second round of bids to be taken in March the following year. The ball was set rolling in what has become a massive programme.

*"[In round 3] we ended up being surprised at how cheap we got the bids in at."*

*Maduna Ngobeni, Principle Energy Officer, IPP Office*

### BACK AT THE BEGINNING

Just how did such a rapid and successful process unfold so quickly? That is where the story is gradual, stemming all the way back to the ANC's energy planning policy at the end of the Apartheid days. That led to a white paper that was published in 1998, that envisaged a completely restructured electrical industry that could electrify the 70% of the population that had no access to electricity. It proposed that 30% of electricity generation should be done by the private sector.

"There were numerous government enquiries and panels and committees and so on," says Mark Pickering, who helped formulate ANC policy then and now runs the South African division of Globeleq, one of the IPPs. "But we couldn't get the political will together because the interests of local government and the interests of the electricity sector just couldn't be resolved. As a result, apart from REIPPP, the sector remains exactly what it was 1994, and that was the same as it was in 1922 when Eskom was created."

But there were some moves towards introducing competition in the power sector, moves that had to confront the basic economic challenge that electricity prices were artificially low because the cost of Apartheid-era infrastructure was not reflected in them. The first private power production in SA came about when the City of Johannesburg sold Kelvin Power station to US energy group AES in 2001. The next effort came in 2006 when government turned to the private sector to construct two open cycle gas turbine plants. Those eventually became Avon and Dedisa, operated by France's Engie and Japan's Mitsui, which between them contribute over 1,000MW to the grid.

These efforts, however, were not particularly successful. Kelvin has since changed hands five times and has never been able to generate to its nameplate capacity. The commissioning of the two gas plants took many years, with construction only beginning in 2014, and were expensive. It is safe to say that independent power production had not won a big following in government.

But renewable energy suddenly became a priority after COP 15 in Copenhagen in 2009. There, president Jacob Zuma surprised everyone by making a public commitment that SA would introduce renewables into its energy mix. "It happened without serious policy debate, certainly not within the ANC," says Anton Eberhard, an academic at the University of Cape Town who has long studied the South African energy sector. "It wasn't originally planned that South Africa would make a significant commitment, but the effect of President Zuma's speech was exactly that. It was a remarkable statement that triggered a process

*"When concrete steps had been taken to avoid the pitfalls of tendering systems around the world, when it became clear that they had a world-class system, then people got excited.*

*Johan van den Berg, CEO of the South African Wind Energy Associatoin*

that became entrenched government policy."

Zuma committed SA to reducing $CO^2$ emissions to 34% below the business-as-usual scenario by 2020 and 42% by 2025. South Africa lobbied heavily for even more aggressive reduction commitments but was blocked by the European Union.

"SA has always had a big presence in the international carbon play, partly out of self-interest to defend its position," says Pickering. "But the people engaged are there also for good moral reasons. It kind of got to the point where we had to put up and shut up and do something and not just be this massively carbon intensive economy, one of the most carbon intensive in the world, preaching to the rest on the global stage."

The country was also being wracked by rolling blackouts which began in October 2007, causing considerable political fallout. Any move towards growth in power capacity met with a positive political wind. The COP 15 announcement became official cabinet policy and a strong commitment was put in place to deliver 10,000MW of renewable capacity by 2013. An integrated resources plan, the DoE's model for future of energy production and supply, incorporated a major component for renewables in 2010.

The problem was, what exactly to do. At the time, the global standard for renewable energy investment was the feed-in tariff model. This involved setting a particular price at which government would buy energy, and then conducting a tender process to select the suppliers. There was also no obvious agency in government to manage such a process. Eventually the National Energy Regulator of South Africa was chosen for the task and it began a process of setting up a feed-in tariff programme.

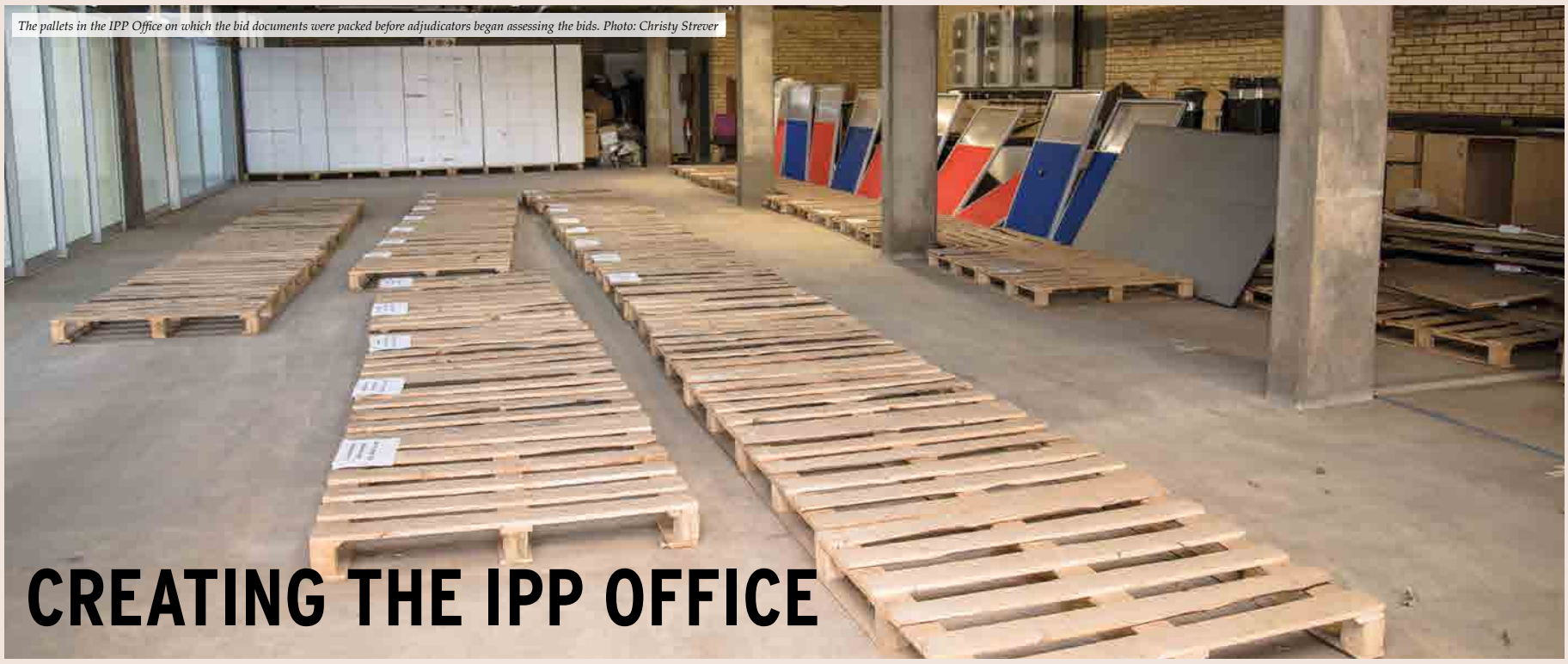
That attracted the interest of international energy companies involved in renewables, as well as some domestic developers. Several arrived in South Africa and opened offices, ready to get on board. The early Nersa indications were of a tariff for wind power of R1.25 per kilowatt hour, which implied a good profit for owners. "Everyone came in and started developing and running as quickly as possible to the front of the queue to be one of the lucky ones to win at that tariff for the 400MW that were expected," says Johan van den Berg, CEO of the South African Wind Energy Association.

The global renewables industry hit a massive slump after the global financial crisis. Major markets like Spain, Italy and Portugal ceased their procurement projects. So there was overcapacity, with companies looking for places to build new projects. That made things far easier for South Africa.

There were all sorts of problems, though, chief among them that a feed-in tariff might be unlawful. The public-private partnership (PPP) unit at National Treasury obtained four legal opinions that said you couldn't use the feed-in tariff model under South African procurement legislation. "We couldn't predetermine a tariff," says Mike Fitzpatrick, a project consultant with J Maynard. "The

*"It kind of got to the point where we had to put up and shut up and do something and not just be this massively carbon intensive economy, one of the most carbon intensive in the world, preaching to the rest on the global stage."*

*Mark Pickering, Managing Director, Globeleq South Africa Management Services*



*The pallets in the IPP Office on which the bid documents were packed before adjudicators began assessing the bids. Photo: Christy Strever*

# CREATING THE IPP OFFICE

When the Department of Energy (DoE) and National Treasury launched the Renewable Energy Independent Power Producers (REIPP) programme, there was no institutional structure in which to incorporate it. There were neither budgets nor enabling legislation. This was both a blessing and a curse – it allowed for flexibility to be able to deliver on the programme rapidly, but with no capacity or funding to do so.

The solution was to create the IPP Office as a project based on a joint agreement between the DoE, National Treasury and the Development Bank of Southern Africa. The DBSA would end up with a financing role in many of the projects and it provided R80m in budget for the office to be set up.

That allowed for the hiring of a large team of consultants who helped develop the process for the first bidding window. But it was done on the fly – the assessment centre for bidding round 1 was set up in a parking lot at Gallagher Estate using temporary structures. The key roleplayers met at each others' houses at nights and over weekends. It had all of the atmosphere of an entrepreneurial start-up rather than a new arm of government bureaucracy.

The same venue was used for bid window 2. "We hired a little office there. We hired a container in the parking lot for the files. We were struggling for money and approvals for us to use anything else," says Karén Breytenbach, the head of the IPP Office.

But after the second round of bidding there were masses of files containing all the documents for the bids so far. So in 2011 the IPP Office obtained its own budget from National Treasury of R100m, enabling it to rent its own building and pay back some of the money from the DBSA.

It set itself up in an office park in Centurion and began to hire full-time staff. The office now has 80 people, many engaged in monitoring all of the approved projects so far and in planning around future bidding rounds. It is now fully self-funded from fees it collects from projects that have closed.

Rather than the temporary structure in the car park, the office now has a purpose built "validation centre" where bid documents are submitted and assessed, complete with high security and monitoring systems. But already that space is proving too small and the IPP Office is about to move to new premises in Centurion.

The IPP Office has also developed a global reputation, creating demand for its services as consultants to projects in other countries, providing a potential future revenue stream from advisory work.

regulator couldn't say the tariff is X, first come, first served. In a competitive environment in terms of constitutional principles, procurement has to be competitive, transparent, open, etc."

Also, Nersa, as the regulator, was in an awkward position trying to procure energy rather than just regulating it. Project developers also complained that the structure of the deals on the table would not be acceptable to banks from a risk perspective.

National Treasury and the DoE collaborated to redesign the process. The solution was an auction system in which bidders competed by pitching the lowest price. There had been some international precedent for such procurement, but only in traditional energy projects. No one had tried it for renewables. And when it became clear the feed-in programme was not going to materialise, the response from the industry was consternation. "They fought bitterly, tooth and nail," says Pickering. "They didn't want to let go of the tariff."

*"At every international conference on energy, SA is being widely acknowledged as having the most successful RE programme ever undertaken."*

*Mike Peo, Head of Infrastructure, Energy and Telecommunications, Nedbank Capital*

Van den Berg says: "Government didn't communicate with us at all. We wrote to the minister and they didn't reply. We got legal opinion about challenging it [the bidding process],". But in the end, government assured the industry that the process would benefit them. "If they'd only told us they envisaged a much bigger thing. When that became clear and when concrete steps had been taken to avoid the pitfalls of tendering systems around the world, when it became clear that they had a world-class system, then people got excited."

There was a lot riding on it for the industry. Many had spent extensively on the feed-in tariff process in preparing to bid. Clive Elliott, chief financial officer of African Infrastructure Investment Managers, a project developer and investor, estimates that the cost of preparing a bid and taking it to financial close in round one was R25m to R30m.

COP 17 was being hosted in Durban in 2011 and the expectations were high for South Africa to deliver tangible progress on the promises made in Copenhagen. So the pressure was on the DoE and Treasury to deliver.

The problem fell into the lap of Breytenbach in 2010, then working in the PPP unit. She worked with deputy director-general Ompi Aphane at the DoE. "He drove it, had the vision," says Breytenbach. "He said from day one that competition was the way to drive prices down. At that time renewable energy was very expensive. We knew affordability was a big issue."

In the industry Breytenbach became a key figure. "She literally went around and kicked everyone's behinds. She got a lot of criticism, but ultimately she was the champion of the process, the pioneering spirit," says Van den Berg.

Breytenbach does not immediately strike you as a hard task master. She has an easy laugh and comes across as a creative, free spirit. But everyone connected to the programme has nothing but praise for her vision and work ethic. "We haven't been easy to


*President Jacob Zuma delivering his speech at the COP15 UN Climate Change Conference in Copenhagen where he made the surprise announcement that SA would introduce renewables into its energy mix. Photo: Gallo Images/Attila Kisbenedek/AFP*

work with," says Breytenbach of her team. "They [the bidders and advisors] will tell you about the horrible woman they had to deal with. But we had a window to deliver this, and we couldn't miss it."

To make it happen, Breytenbach quickly assembled a team of experts. "She signed them up – the best people from all the best law firms, engineering firms, technical, environmental, etc – and she just went and got them," says Pickering. That made it possible to get the request for proposals out by that August. And on 7 December the minister announced the winners at Durban, then the biggest renewable energy programme ever, a coup for South Africa.

One unusual aspect of the approach was that bids would not be assessed on price alone. Some 30% of the assessment was based on an economic development plan, which involved allocating 1.5% to 3% of turnover to development of the local communities around projects. This was a new challenge for the industry, used to building and operating straight-forward utilities. It also took a special exemption from the Preferential Procurement Policy Framework Act, which stipulates that 90% of the weighting in any tender should be on price. The economic development aspect improved the programme's impact on National Development Plan objectives. That was in addition to several local procurement, ownership and job creation requirements.

The prices in the first round were expensive. The industry had relented on the feed-in tariff model, but the prices discussed became a guide for bidders in the auction. The IPP office decided to set a maximum price for bids, rather than leaving it entirely to the market place, and most bids were almost at that price. While 56 bids were made, only 28 were deemed in the assessment to be compliant, and all 28 became winners, collectively supplying 2,128MW. The competition effectively turned on who could comply with the process rather than who was cheapest.

But there were three critical features of the first round that drove the later success. The first was that it was structured as a series of rounds. So losers in round 1 could bid again in round 2, so the investment in preparing a bid for round 1 was not lost. Second was that the IPP Office decided to give detailed feedback to each bidder, what had worked and what hadn't. Third was that the high prices caught the world's attention. Together, those factors had a galvanising impact for the subsequent rounds. →

# CONSTRUCTING ON TIME AND ON BUDGET

*A Siemens turbine being assembled at the Jeffreys Bay Wind Farm. The project has been operational since mid-2014. Photo: IPP Office*

Once the champagne is consumed and signatures on all the contracts are dry, the hard part of building the new plants springs to life. In typical project management structures, the task of constructing the plant is in the hands of a contractor called an "engineering, procurement, construction" contractor or EPC for short. Once the plant is fully ready they hand over to an "operations and maintenance" team, generally known as an O&M.

The REIPPs have an impressive track record of constructing plants on time and on budget. The first producer to reach operating stage, Scatec Solar's Kalkbult 75MW photovoltaic plant in the Northern Cape, was built in just nine months and was ready three months ahead of schedule. It started supplying in September 2013.

"As soon as we had preferred bidder status we started to employ people, before we got to financial close," says Clive Elliott, chief financial officer of developer African Infrastructure Investment Managers. "You needed to be pretty certain you had a team in place at least six months before financial close." That team then needed to work with the EPC contractor to plan everything from the first earth digging right through to beginning full commercial operation.

On average, each plant has taken about one year and nine months to complete. There have been delays to projects coming online, at an average of 76 days, though this has been shrinking since the projects of the first bid window. Delays are usually caused by late connections to the Eskom grid, or problems in the construction phase, including accidents and delays in obtaining equipment from suppliers.

The problems that emerged had to be decisively managed. The biggest project in round 1, the Cookhouse Wind Farm, came down to the wire after the main contractor and turbine manufacturer, Suzlon, hit financial straits. Following the 2009 downturn in the global energy market, the Indian firm had struggled. At one point all of the parties involved scrambled into action to ensure the firm could deliver. As it was, there was a three-month delay. In terms of the contracts, that led to penalties to be paid by Suzlon which amounted to R250m.

A far more tragic delay befell Khi Solar One, a concentrated solar power plant outside Upington at which a high central tower was being constructed. During bad weather a 198m high crane collapsed onto an office, killing one worker and seriously injuring others. The disaster led to a one-year delay. ■

## ROUND 2 AND BEYOND

After the announcement of the winners in the first round, the government and bidders had to secure financial close before construction could begin. This involved finalising all of the elements of the project including the funding, suppliers and a power purchase agreement with Eskom. It included all the permits and licences that would be needed to construct and operate the plants; one developer says there were 36 different permits needed.

Initially, the hope was to achieve financial close by June 2012, but in the end it took until November. It was the first time such a process had been undertaken and all parties took longer to reach finalisation than thought.

Difficult issues were the purchase guarantee that was underwritten by National Treasury. This provided certainty that the 20-year power purchase agreements were entirely creditworthy, which was necessary for banks to finance the projects. All of the risks sat with the owners who had to find ways to lock in costs in order to supply in terms of their winning bids for 20 years. Construction began immediately and the first IPP began production just a year later.

"We became smarter and more efficient for bid window 2," says Breytenbach. Several aspects of the process were tightened up to encourage competition. With bid window one having been concluded, a great deal of uncertainty was removed for potential developers. The amount of energy to be procured fell, allowing the IPP Office to be choosier about winners. It also tried to encourage small producers, in the region of 5MW. The second window followed hot on the heels after the first. It was announced at the same time as the winners of round 1, with a submission deadline of March 2012.

While South Africa already stood out in the global scene before bid window 1, it became a very bright beacon afterwards. "We never realised the interest the programme would attract," says Breytenbach. But by now it was the hottest opportunity in global energy development.

Theuns Ehlers, Absa's head of resource and project finance, says the big international players in particular stepped up their interest after round 1 – and became more aggressive in terms of pricing the deals. "That's exactly what the government wanted from a tariff perspective – a competitive basis to the bidding. In some rounds they were four to five times oversubscribed."

There were 79 bidders in round 2, and just 19 were successful. Many of the successful bidders in round 1 failed to secure a project in round 2. This time, price was the decisive factor in the success of bids and prices fell by an average of 34% from bid window 1 to 2, and local content targets improved.

The third bidding round was held in August 2013, when 93 bids were received offering a total of 6,023MW of energy production. In that round 17 bidders were chosen, representing 1,456MW-worth of new capacity, and announced in November 2013. Prices fell again, this time by another 19%.

"In every bid round we learn," says Ngobeni. "In bid window 3 we introduced a new, revised, RFP [request for proposals] which took into account everything we learnt. We consolidated all the briefing notes we had created for bidders into that and updated it. And we ended up being surprised at how cheap we got the bids in at."

Another change was that the cap on bid prices was dropped, so prices now were subject only to market forces. The requirements were also streamlined in an effort to reduce the costs of preparing a bid.

In round 3, the IPP Office wanted to increase the number of accepted bids, but couldn't in terms of the rules for that round. But that was changed for round 4, when it gave itself the flexibility to accept more capacity than set for the bidding window. In that round, the target was 1,105MW but it ended up accepting bids for 2,200MW from 26 winning bidders out of 77 respondents.

For the fourth round the price fell dramatically again, by another 39%, and was announced in April 2015 and June 2015, the latter for preferred bidders from round 4 that is sometimes called round 4.5. At an average price of 82c/kwh, the total cost is less than the cost of electricity that will be generated by Eskom's Medupi and Kusile power stations. In rounds 3 and 4 there was also more focus on less common technologies like biomass and landfill.

With the announcement of the round 4 winners, energy minister Tina Joemat-Pettersson also gave details of an acceleration and expansion of the REIPPP programme. Two new bidding windows were announced, a so-called "expedited" round for which all previous unsuccessful bidders could bid, and a fifth bid window to take place in the second quarter of 2016. Alongside that, a small projects programme was also announced for projects of 1MW to 5MW in size, the sort of project a factory might have on its roof (see side bar). Because such projects are too small to justify extensive development costs or to attract large-scale funders, special rules were created to facilitate it.

The minister also announced that the same procurement approach would be used to acquire 3,126MW worth of gas power generation. Already, the IPP Office had been tasked with conducting the procurement for two coal power stations.

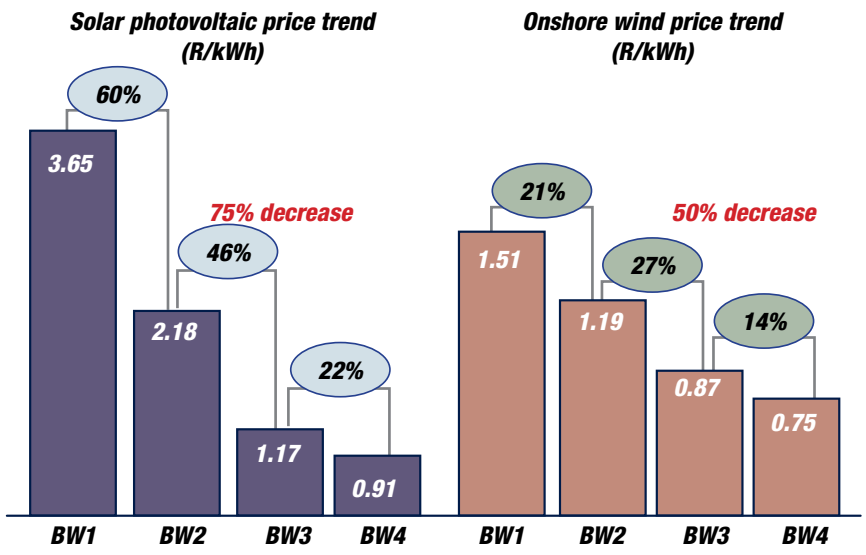
That expansion trajectory has stalled somewhat. We take up the story of the future of the programme on page 34. But what has been achieved so far is remarkable: as of mid-October, 6,800MW of energy capacity have been procured, of which a third is already contributing to the grid.

After the heady days of 2011 in the parking lot of Gallagher Estate, the IPP Office has become a master of procurement. "Now it's a cookie cutter process," says Breytenbach.

"There's no question about it," says Nedbank infrastructure head Mike Peo. "At every international conference on energy, SA is being widely acknowledged having the most successful RE programme ever undertaken. There is no other country procuring as quickly as we did." ■

**The rapidly falling cost of renewable energy across the four bid windows (BW)**

Prices in April 2016 terms




Source: IPP Office

# SMALL IPP PROGRAMME OPENS THE INDUSTRY TO SMEs

*Colin Anthony*

One more goal of the REIPPP programme was the promotion of small businesses in the energy mix. The "small IPP" programme, as it has been dubbed, is for plants to produce 5MW or less with renewable technology. The IPP Office says it is aimed at giving South African power generation equipment manufacturers, who may not have international certification, the opportunity to supply equipment for the projects.

"During the process we realised that the domestic South African manufacturing part was not growing, although it was always a requirement," says Karén Breytenbach, head of the IPP Office. "In bid window 2 we started with space for small producers to make it easier for them to participate, but we weren't that successful. It was difficult for them to pay for the lawyers and other experts they needed to construct a bid." So a special "small IPPs" bid window was conceptualised with lighter bid requirements and special funding arrangements. That has been conducted and 10 projects selected, but the financial close of the winning projects has been delayed.

One private sector response to the challenge facing small operators was developed by Mergence Investment Managers. "It's a very good initiative that runs parallel to the main process, says Mergence senior investment analyst Peta Chennells. "The logic behind it is to create jobs. We want it to be supportive of and friendly to SMEs. The concept opens the industry to SMEs whereas previously they were unable to compete."

Typically in an RE project, she says, about 75MW is produced, with the big ones producing 140MW. For smaller projects limited to 5MW, problems arise with project finance. "The costs are similar for a small 5MW project, so it's very tricky to get that right. You can do this profitably if you're clever about it."

Mergence negotiated with suppliers to get capped mandates spread across the portfolio for economies of scale. "We negotiated bulk deals, treating them as joint rather than individual entities," she says. "But it's the same amount of work as the large projects so it does make things difficult.

"We had a good idea of the quality of the projects so we were comfortable with them. Not just the costs but the due diligence is the same as for the large projects. We negotiated agreements after conducting very intensive due diligence."

The delay in securing financial close is hurting the businesses involved. Chennels says that for Eskom a 5MW project "isn't a big thing", while the benefits for SMEs are massive. "The problem is SMEs don't have big balance sheets so the delay is hurting them.

"We're engaging with the Department of Energy, they have been proactive in responding. I am definitely confident that financial close will be achieved."

"It's nice to be part of something new in SA and I'm really looking forward to see how and where it goes from here." ■

Photo Essay: Khi Solar One

# A STAR IN THE SKY

*As the sun rises outside Upington the top of the tower begins to light up.*

*The heliostats focus the 140m² mirror panels so as to direct the sun's rays towards the top of the tower. This picture was taken early in the morning when there is enough moisture in the air to light up the sun's rays. Photo: Christy Strever*

**THE COLLECTION UNITS ATOP THE KHI SOLAR ONE TOWER CAN BE SEEN FROM 30KM AWAY, HANGING LIKE A SECOND SUN IN THE SKY OUTSIDE UPINGTON IN THE NORTHERN CAPE.**

It was the first concentrated solar tower power plant in Africa when it opened in February this year. The tower is 205m high and doubles as a cooling tower. Around it, spaced out like a fan, are 4,120 mirror panels, each one about 140m², mounted on heliostats that move them to focus the sun's rays on the top of the tower throughout the day.

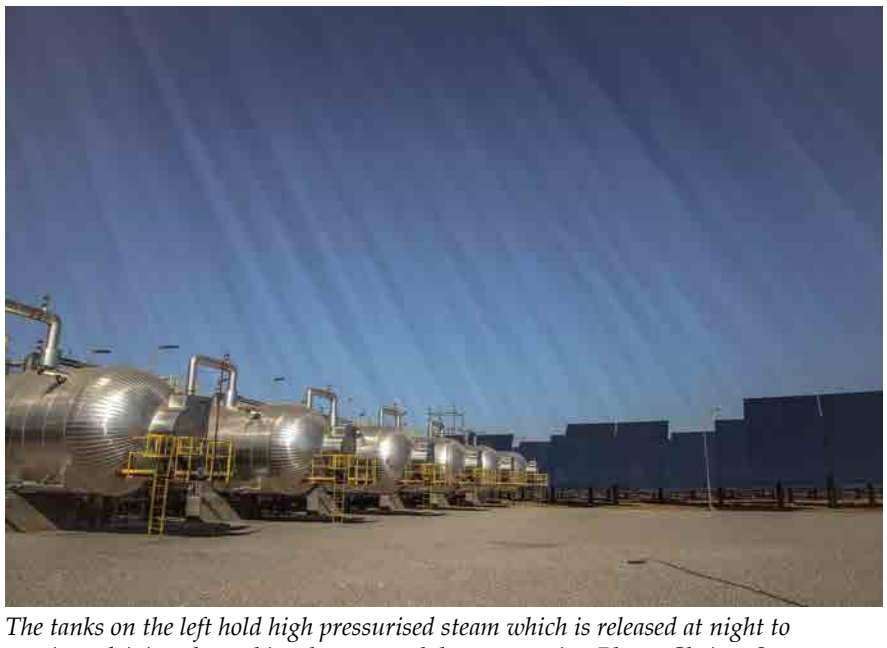
The top of the tower holds three receiver units, each the size of a 10-storey building. In the two on either side, pressurised steam is heated up to 200ºC, which is then fed into the centre receiver unit where it is further heated up to 400ºC. It is then fed down the tower into a generating turbine at the bottom that generates up to 50MW of electricity. At peak times, excess steam is stored in pressurised tanks which is then released at night to continue driving the turbine for two hours, though at a much lower capacity. Depressurised steam from the turbine is fed into the tower which doubles as a cooling tower. The core is hollow.

The controlling shareholder in the project is Spanish utility company Abengoa.

| Key Facts | |
|---|---|
| Location: | 20km Southwest of Upington, Northern Cape |
| Energy produced: | 50MW |
| Site area: | 140 hectares |
| Start of full operations: | February 2016 |
| Technology: | Concentrated solar power, tower |
| Project cost: | Not disclosed |
| REIPPP window: | Round: 1 |
| Owner: | Abengoa 51%, Industrial Development Corporation 29%, Community Development Trust, 20%. |

*This picture was taken from the top of the tower and shows the array of mirrors below it. Photo: Christy Strever*

*The generating plant reticulates pressurised steam. The turbine unit is on the left. Photo: Christy Strever*



*The tanks on the left hold high pressurised steam which is released at night to continue driving the turbine, but at much lower capacity. Photo: Christy Strever*

*A shot down the tower from the top. It doubles as a cooling tower so at the top there is a strong wind blowing upwards as the hot water at the bottom heats the air. The tower is equivalent in height to a 50-storey building. Photo: Christy Strever*

Photo Essay: Cookhouse Wind Farm

# THOSE BRIGHT, GODLY MILLS

*A view over Cookhouse Wind Farm and neighbouring wind farm Nojoli. Photo: Christy Strever*

*The Cookhouse turbines on a windy morning tower above cows grazing in the fields nearby. Photo: Supplied by IPP Office*

**WIND HAS BEEN AMONG THE MOST PROMINENT ENERGY TECHNOLOGIES IN THE REIPPP PROGRAMME. ONE MAJOR CENTRE OF ACTIVITY HAS BEEN COOKHOUSE IN THE EASTERN CAPE, ABOUT TWO HOURS' DRIVE FROM PORT ELIZABETH. PE HAS LONG BEEN CALLED THE WINDY CITY SO IT'S NO SURPRISE THAT WIND ENERGY FARMS HAVE SPRUNG UP AROUND IT.**

The main feature of wind farms are the enormous wind turbines and on the hills above Cookhouse – they make a muted drone as the blades slowly slice through the air. The turbines at Cookhouse Wind Farm, manufactured by Indian firm Suzlon, stand at 80m high with blades that are each 43m long. At maximum wind strength, the hub turns at 15 revolutions per minute but a gearbox just behind the hub increases this to 1,500rpm. That spins a turbine that generates 2.1MW of electricity in each mast. At the Cookhouse Wind Farm, there are 66 windmills so the total energy generated adds up to 138.6MW, making it among the largest IPPs so far.

The farm is one of three already built in the same area in Cookhouse, with two more still planned for construction. When all is done there will be around 200 turbines spaced along the Cookhouse ridge. The spacing is important – the mills generate a "wake" just like boats in water, which can cause disturbances to other turbines nearby.

The main shareholders operate through a joint venture between Old Mutual and Australia's Macquarie.

| Key Facts | |
|---|---|
| Location: | Cookhouse, Eastern Cape |
| Energy produced: | 138.6MW |
| Start of full operations: | December 2014 |
| Technology: | Wind |
| Project cost: | R2.24bn |
| REIPPP window: | 1 |
| Owner: | Apollo Investment Partnership II 39%, Africa Infrastructure Investment Fund 2 Partnership 6.9%, Africa Infrastructure Investment Fund 2 (Mauritius) 7.1%, Old Mutual SA 14.5%, Cookhouse Community Trust 25%, AFPOC Limited 7.5%. |

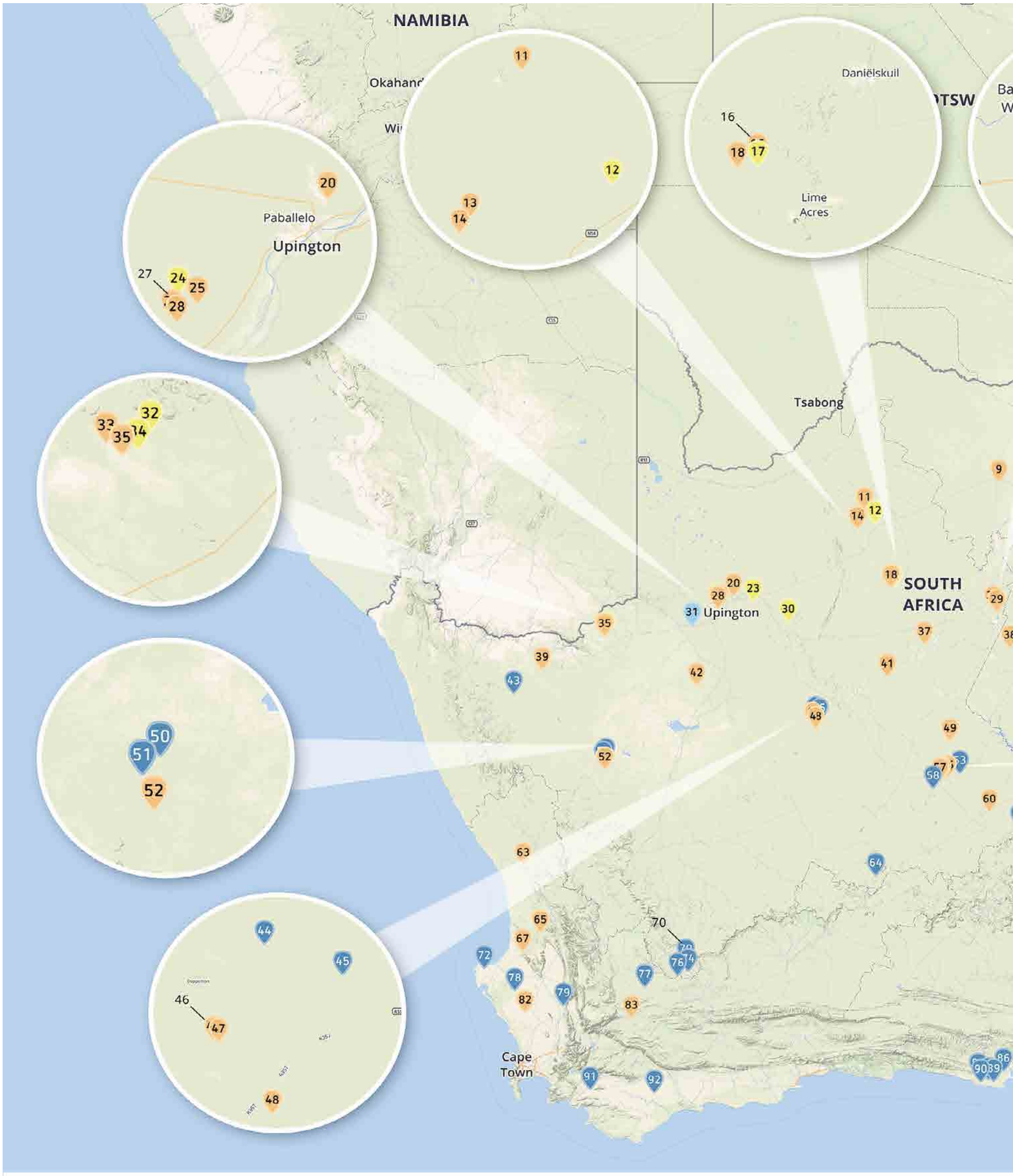
*Before construction the turbine towers and blades arrived after being manufactured in India. Photo: Supplied by Cookhouse Wind Farm*


*Each blade had to be transported individually. The wind farm has 66 turbines each with three blades, so that made for almost 200 trips. Photo: Supplied by Cookhouse Wind Farm*


*During construction, large cranes are used to assemble the tower and blades. Photo: Supplied by IPP Office*

# ACROSS THE COUNTRY

*In this map we mark the locations of 92 projects in the programme using six different renewable*




*Power plants selected in windows 1 to 4 of South Africa's Renewable Energy IPP Programme*

| Solar PV | Solar CSP | Wind | Biomass | Landfill Gas | Small Hydro |
|---|---|---|---|---|---|

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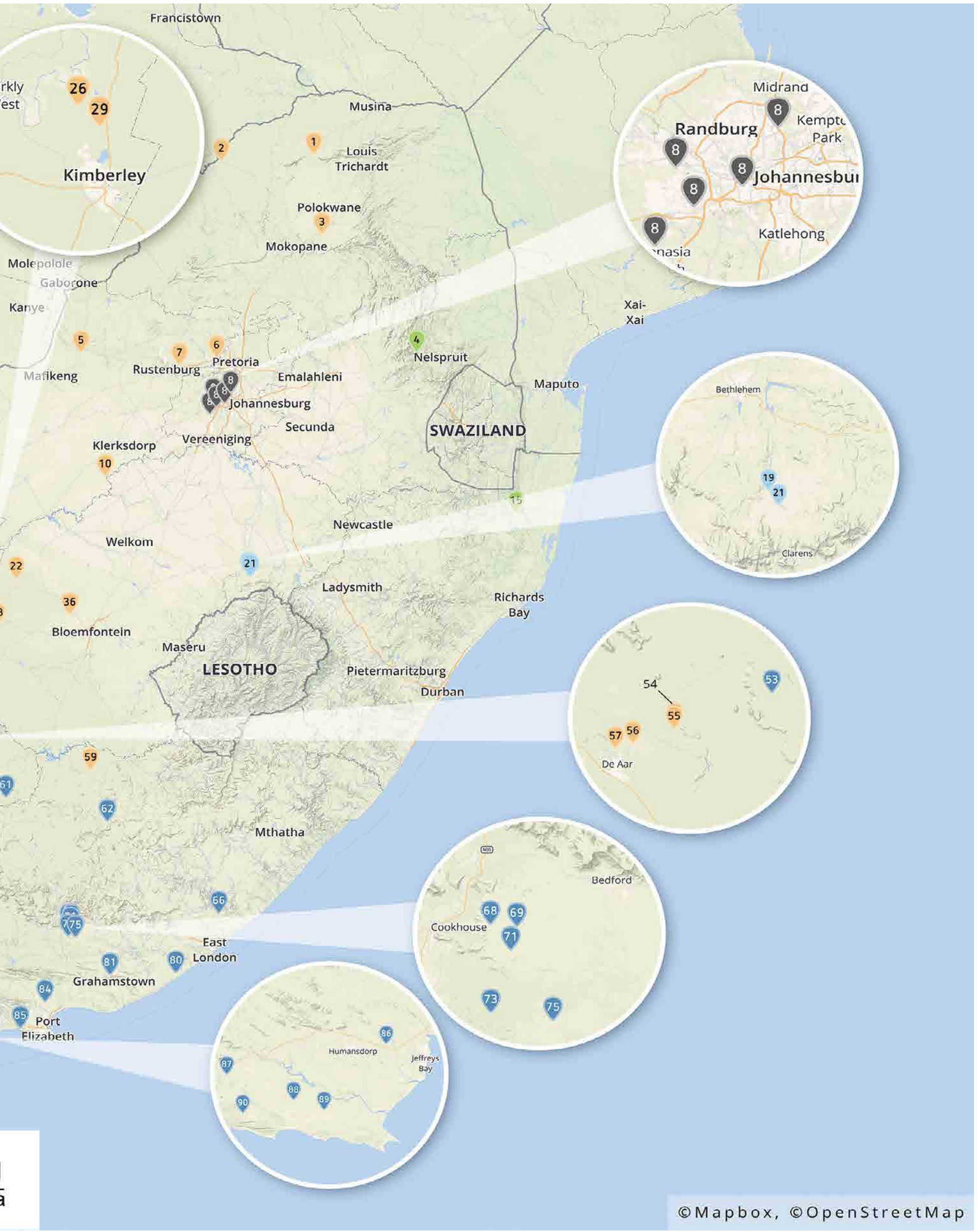
*technologies. See overleaf for key and details of each project.*



## The projects and progress in the renewable energy programme

# THE STATE OF PLAY

*See map on previous page*

*Source: Energy Blog*

| MAP ID | ID | TITLE | MEGA-WATTS | PROGRAMME | PROJECT TYPE | PROVINCE | STATUS | TOWN |
|---|---|---|---|---|---|---|---|---|
| 1 | 22 | Soutpan Solar Park | 28 | REIPPP Window 1 | Solar Photovoltaic (PV) | Limpopo | Fully operational | Mokopane |
| 2 | 52 | Tom Burke Solar Park | 60 | REIPPP Window 3 | Solar Photovoltaic (PV) | Limpopo | Fully operational | Lephalale |
| 3 | 23 | Witkop Solar Park | 30 | REIPPP Window 1 | Solar Photovoltaic (PV) | Limpopo | Fully operational | Polokwane |
| 4 | 82 | Ngodwana Biomass Power Station | 62 | REIPPP Window 4 | Biomass | Mpumalanga | Approvals, planning and financing | Ngodwana |
| 5 | 94 | Zeerust | 75 | REIPPP Window 4 | Solar Photovoltaic (PV) | North-West Province | Approvals, planning and financing | Zeerust |
| 6 | 92 | De Wildt | 50 | REIPPP Window 4 | Solar Photovoltaic (PV) | North-West Province | Approvals, planning and financing | Brits |
| 7 | 14 | RustMo1 Solar Farm | 6.8 | REIPPP Window 1 | Solar Photovoltaic (PV) | North-West Province | Fully operational | Rustenburg |
| 8 | 66 | Johannesburg Landfill Gas to Electricity (Ennerdale) | | REIPPP Window 3 | Landfill Gas | Gauteng | Partially operational | Johannesburg |
| 8 | 66 | Johannesburg Landfill Gas to Electricity (Marie Louise) | | REIPPP Window 3 | Landfill Gas | Gauteng | Partially operational | Johannesburg |
| 8 | 66 | Johannesburg Landfill Gas to Electricity (Goudkoppies) | | REIPPP Window 3 | Landfill Gas | Gauteng | Partially operational | Johannesburg |
| 8 | 66 | Johannesburg Landfill Gas to Electricity (Robinson Deep) | 5 | REIPPP Window 3 | Landfill Gas | Gauteng | Partially operational | Johannesburg |
| 8 | 66 | Johannesburg Landfill Gas to Electricity (Linbro Park) | 1 | REIPPP Window 3 | Landfill Gas | Gauteng | Partially operational | Johannesburg |
| 9 | 96 | Waterloo Solar Park | 75 | REIPPP Window 4 | Solar Photovoltaic (PV) | North-West Province | Approvals, planning and financing | Vryburg |
| 10 | 93 | Bokamoso | 68 | REIPPP Window 4 | Solar Photovoltaic (PV) | North-West Province | Approvals, planning and financing | Leeudoringstad |
| 11 | 50 | Adams Solar PV 2 | 82.5 | REIPPP Window 3 | Solar Photovoltaic (PV) | Northern Cape | Construction | Hotazel |
| 12 | 97 | Kathu Solar Park | 100 | REIPPP Window 3 | Concentrated Solar Thermal (CSP) | Northern Cape | Construction | Kuruman |
| 13 | 32 | Sishen Solar Facility | 74 | REIPPP Window 2 | Solar Photovoltaic (PV) | Northern Cape | Fully operational | Sishen |
| 14 | 30 | Kathu Solar Energy Facility | 75 | REIPPP Window 1 | Solar Photovoltaic (PV) | Northern Cape | Fully operational | Kathu |
| 15 | 67 | Mkuze | 16 | REIPPP Window 3 | Biomass | KwaZulu-Natal | Approvals, planning and financing | Mkuze |
| 16 | 37 | Jasper Power Company | 75 | REIPPP Window 2 | Solar Photovoltaic (PV) | Northern Cape | Fully operational | Postmasburg |
| 17 | 98 | Redstone CSP | 100 | REIPPP Window 3 | Concentrated Solar Thermal (CSP) | Northern Cape | Approvals, planning and financing | Postmasburg |
| 18 | 28 | Lesedi Power Company | 64 | REIPPP Window 1 | Solar Photovoltaic (PV) | Northern Cape | Fully operational | Postmasburg |
| 19 | 81 | Kruisvallei Hydro | 4.5 | REIPPP Window 4 | Small Hydro | Free State | Approvals, planning and financing | Bethlehem |
| 20 | 39 | Upington Solar PV | 8.9 | REIPPP Window 2 | Solar Photovoltaic (PV) | Northern Cape | Fully operational | Upington |
| 21 | 47 | Stortemelk Hydro (Pty) Ltd | 4.3 | REIPPP Window 2 | Small Hydro | Free State | Fully operational | Clarens |
| 22 | 38 | Boshoff Solar Park | 60 | REIPPP Window 2 | Solar Photovoltaic (PV) | Free State | Fully operational | Boshof |
| 23 | 65 | Ilanga CSP 1 (Karoshoek Consortium) | 100 | REIPPP Window 3 | Concentrated Solar Thermal (CSP) | Northern Cape | Construction | Kimberley |
| 24 | 11 | Khi Solar One | 50 | REIPPP Window 1 | Concentrated Solar Thermal (CSP) | Northern Cape | Fully operational | Upington |
| 25 | 70 | Sirius Solar PV Project One | 75 | REIPPP Window 4 | Solar Photovoltaic (PV) | Northern Cape | Approvals, planning and financing | Upington |
| 26 | 75 | Droogfontein 2 Solar | 75 | REIPPP Window 4 | Solar Photovoltaic (PV) | Northern Cape | Approvals, planning and financing | Kimberley |
| 27 | 72 | Dyason's Klip 2 | 75 | REIPPP Window 4 | Solar Photovoltaic (PV) | Northern Cape | Approvals, planning and financing | Upington |
| 28 | 71 | Dyason's Klip 1 | 75 | REIPPP Window 4 | Solar Photovoltaic (PV) | Northern Cape | Approvals, planning and financing | Upington |
| 29 | 26 | Droogfontein Solar Power | 50 | REIPPP Window 1 | Solar Photovoltaic (PV) | Northern Cape | Fully operational | Kimberley |
| 30 | 49 | Bokpoort CSP Project | 50 | REIPPP Window 2 | Concentrated Solar Thermal (CSP) | Northern Cape | Fully operational | Groblershoop |
| 31 | 48 | Neusberg Hydro Electric Project A | 10 | REIPPP Window 2 | Small Hydro | Northern Cape | Fully operational | Kakamas |
| 32 | 12 | KaXu Solar One | 100 | REIPPP Window 1 | Concentrated Solar Thermal (CSP) | Northern Cape | Fully operational | Pofadder |
| 33 | 16 | Konkoonsies Solar | 9.7 | REIPPP Window 1 | Solar Photovoltaic (PV) | Northern Cape | Fully operational | Pofadder |
| 34 | 64 | Xina CSP South Africa | 100 | REIPPP Window 3 | Concentrated Solar Thermal (CSP) | Northern Cape | Construction | Pofadder |
| 35 | 73 | Konkoonsies II Solar Facility | 75 | REIPPP Window 4 | Solar Photovoltaic (PV) | Northern Cape | Approvals, planning and financing | Pofadder |
| 36 | 27 | Letsatsi Power Company | 64 | REIPPP Window 1 | Solar Photovoltaic (PV) | Free State | Fully operational | Bloemfontein |
| 37 | 20 | Herbert PV Power Plant | 19.9 | REIPPP Window 1 | Solar Photovoltaic (PV) | Northern Cape | Fully operational | Douglas |
| 38 | 55 | Pulida Solar Park | 75 | REIPPP Window 3 | Solar Photovoltaic (PV) | Free State | Awaiting construction (approved & financed) | Kimberley |
| 39 | 74 | Aggeneys Solar Project | 40 | REIPPP Window 4 | Solar Photovoltaic (PV) | Northern Cape | Approvals, planning and financing | Aggeneys |

*Hopefield Wind Farm (Photo provided by IPP Office)*

*Jeffreys Bay Wind Farm (Photo provided by IPP Office)*

| MAP ID | ID | TITLE | MEGA-WATTS | PROGRAMME | PROJECT TYPE | PROVINCE | STATUS | TOWN |
|---|---|---|---|---|---|---|---|---|
| 40 | 95 | Greefspan PV Power Plant No. 2 Solar Park | 55 | REIPPP Window 4 | Solar Photovoltaic (PV) | Northern Cape | Approvals, planning and financing | Douglas |
| 41 | 19 | Greefspan PV Power Plant | 10 | REIPPP Window 1 | Solar Photovoltaic (PV) | Northern Cape | Fully operational | Douglas |
| 42 | 17 | Aries Solar | 9.7 | REIPPP Window 1 | Solar Photovoltaic (PV) | Northern Cape | Fully operational | Kenhardt |
| 43 | 85 | Kangnas Wind Farm | 137 | REIPPP Window 4 | Onshore Wind | Northern Cape | Approvals, planning and financing | Springbok |
| 44 | 89 | Copperton Windfarm | 102 | REIPPP Window 4 | Onshore Wind | Northern Cape | Approvals, planning and financing | Copperton |
| 45 | 90 | Garob Wind Farm | 136 | REIPPP Window 4 | Onshore Wind | Northern Cape | Approvals, planning and financing | Copperton |
| 46 | 21 | Mulilo Renewable Energy Solar PV Prieska | 19.9 | REIPPP Window 1 | Solar Photovoltaic (PV) | Northern Cape | Fully operational | Prieska |
| 47 | 56 | Mulilo Prieska PV | 75 | REIPPP Window 3 | Solar Photovoltaic (PV) | Northern Cape | Fully operational | Prieska |
| 48 | 53 | Mulilo Sonnedix Prieska PV | 75 | REIPPP Window 3 | Solar Photovoltaic (PV) | Northern Cape | Fully operational | Prieska |
| 49 | 29 | Kalkbult | 72.5 | REIPPP Window 1 | Solar Photovoltaic (PV) | Northern Cape | Fully operational | De Aar |
| 50 | 63 | Loeriesfontein 2 Wind Farm | 138 | REIPPP Window 3 | Onshore Wind | Northern Cape | Construction | Loeriesfontein |
| 51 | 61 | Khobab Wind Farm | 138 | REIPPP Window 3 | Onshore Wind | Northern Cape | Construction | Loeriesfontein |
| 52 | 91 | Solar Capital Orange | 75 | REIPPP Window 4 | Solar Photovoltaic (PV) | Northern Cape | Approvals, planning and financing | Loeriesfontein |
| 53 | 58 | Longyuan Mulilo De Aar 2 North Wind Energy Facility | 139 | REIPPP Window 3 | Onshore Wind | Northern Cape | Construction | De Aar |
| 54 | 31 | Solar Capital De Aar (Pty) Ltd | 75 | REIPPP Window 1 | Solar Photovoltaic (PV) | Northern Cape | Fully operational | De Aar |
| 55 | 2 | Solar Capital De Aar 3 | 75 | REIPPP Window 1 | Solar Photovoltaic (PV) | Northern Cape | Fully operational | De Aar |
| 56 | 25 | De Aar Solar Power | 50 | REIPPP Window 1 | Solar Photovoltaic (PV) | Northern Cape | Fully operational | De Aar |
| 57 | 15 | Mulilo Renewable Energy Solar PV De Aar | 9.7 | REIPPP Window 1 | Solar Photovoltaic (PV) | Northern Cape | Fully operational | De Aar |
| 58 | 60 | Longyuan Mulilo De Aar Maanhaarberg Wind Energy Facility | 96 | REIPPP Window 3 | Onshore Wind | Northern Cape | Construction | De Aar |
| 59 | 36 | Dreunberg | 75 | REIPPP Window 2 | Solar Photovoltaic (PV) | Eastern Cape | Fully operational | Dreunberg |
| 60 | 35 | Linde | 36.8 | REIPPP Window 2 | Solar Photovoltaic (PV) | Northern Cape | Fully operational | Hanover |
| 61 | 62 | Noupoort Mainstream Wind | 79 | REIPPP Window 3 | Onshore Wind | Northern Cape | Fully operational | Noupoort |
| 62 | 8 | Dorper Wind Farm | 97 | REIPPP Window 1 | Onshore Wind | Eastern Cape | Fully operational | Molteno/ Sterkstoom |
| 63 | 34 | Vredendal | 8.8 | REIPPP Window 2 | Solar Photovoltaic (PV) | Western Cape | Fully operational | Vredendal |
| 64 | 6 | Noblesfontein | 72.8 | REIPPP Window 1 | Onshore Wind | Northern Cape | Fully operational | Noblesfontein |
| 65 | 54 | Electra Capital - Paleisheuwel Solar Park | 75 | REIPPP Window 3 | Solar Photovoltaic (PV) | Western Cape | Fully operational | Clanwilliam |
| 66 | 46 | Chaba | 20.6 | REIPPP Window 2 | Onshore Wind | Eastern Cape | Fully operational | Komga |
| 67 | 33 | Aurora | 10.35 | REIPPP Window 2 | Solar Photovoltaic (PV) | Western Cape | Fully operational | Aurora |
| 68 | 10 | Cookhouse Wind Farm | 135 | REIPPP Window 1 | Onshore Wind | Eastern Cape | Fully operational | Cookhouse |
| 69 | 78 | Nxuba Wind Farm | 140 | REIPPP Window 4 | Onshore Wind | Eastern Cape | Approvals, planning and financing | Cookhouse |
| 70 | 84 | The Soetwater Wind Farm | 139 | REIPPP Window 4 | Onshore Wind | Northern Cape | Approvals, planning and financing | Laingsburg |
| 71 | 59 | Nojoli Wind Farm | 87 | REIPPP Window 3 | Onshore Wind | Eastern Cape | Construction | Cookhouse |
| 72 | 43 | West Coast 1 | 90.8 | REIPPP Window 2 | Onshore Wind | Western Cape | Fully operational | Vredenburg |
| 73 | 76 | Golden Valley | 120 | REIPPP Window 4 | Onshore Wind | Eastern Cape | Approvals, planning and financing | Cookhouse |
| 74 | 79 | Karusa Wind Farm | 140 | REIPPP Window 4 | Onshore Wind | Northern Cape | Approvals, planning and financing | Sutherland |
| 75 | 41 | Amakhala Emoyeni (Phase 1) | 134.4 | REIPPP Window 2 | Onshore Wind | Eastern Cape | Fully operational | Bedford |
| 76 | 77 | Roggeveld | 140 | REIPPP Window 4 | Onshore Wind | Western Cape | Approvals, planning and financing | Sutherland |
| 77 | 86 | Perdekraal East Wind Farm | 108 | REIPPP Window 4 | Onshore Wind | Western Cape | Approvals, planning and financing | Matjiesfontein |
| 78 | 5 | Hopefield Wind Farm | 65.4 | REIPPP Window 1 | Onshore Wind | Western Cape | Fully operational | Hopefield |
| 79 | 40 | Gouda Wind Facility | 135.2 | REIPPP Window 2 | Onshore Wind | Western Cape | Fully operational | Gouda |
| 80 | 88 | Wesley-Ciskei Wind Farm | 33 | REIPPP Window 4 | Onshore Wind | Eastern Cape | Approvals, planning and financing | Peddie |
| 81 | 44 | Waainek | 23.4 | REIPPP Window 2 | Onshore Wind | Eastern Cape | Fully operational | Grahamstown |
| 82 | 13 | SlimSun Swartland Solar Park | 5 | REIPPP Window 1 | Solar Photovoltaic (PV) | Western Cape | Fully operational | Swartland |
| 83 | 24 | Touwsrivier Project | 36 | REIPPP Window 1 | Solar Photovoltaic (PV) | Western Cape | Fully operational | Touwsrivier |
| 84 | 45 | Grassridge | 59.8 | REIPPP Window 2 | Onshore Wind | Eastern Cape | Fully operational | Port Elizabeth |
| 85 | 4 | MetroWind Van Stadens Wind Farm | 27 | REIPPP Window 1 | Onshore Wind | Eastern Cape | Fully operational | Port Elizabeth |
| 86 | 9 | Jeffreys Bay Wind Farm | 138 | REIPPP Window 1 | Onshore Wind | Eastern Cape | Fully operational | Jeffreys Bay |
| 87 | 42 | Tsitsikamma Community Wind Farm | 94.8 | REIPPP Window 2 | Onshore Wind | Eastern Cape | Fully operational | Tsitsikamma |
| 88 | 80 | Oyster Bay Wind Farm | 140 | REIPPP Window 4 | Onshore Wind | Eastern Cape | Approvals, planning and financing | Oyster Bay |
| 89 | 7 | Kouga Wind Farm - Oyster Bay | 80 | REIPPP Window 1 | Onshore Wind | Eastern Cape | Fully operational | St Francis Bay |
| 90 | 57 | Red Cap - Gibson Bay | 111 | REIPPP Window 3 | Onshore Wind | Eastern Cape | Construction | St Francis Bay |
| 91 | 3 | Dassiesklip Wind Energy Facility | 26.2 | REIPPP Window 1 | Onshore Wind | Western Cape | Fully operational | Caledon |
| 92 | 87 | Excelsior Wind Energy Facility | 32 | REIPPP Window 4 | Onshore Wind | Western Cape | Approvals, planning and financing | Swellendam |

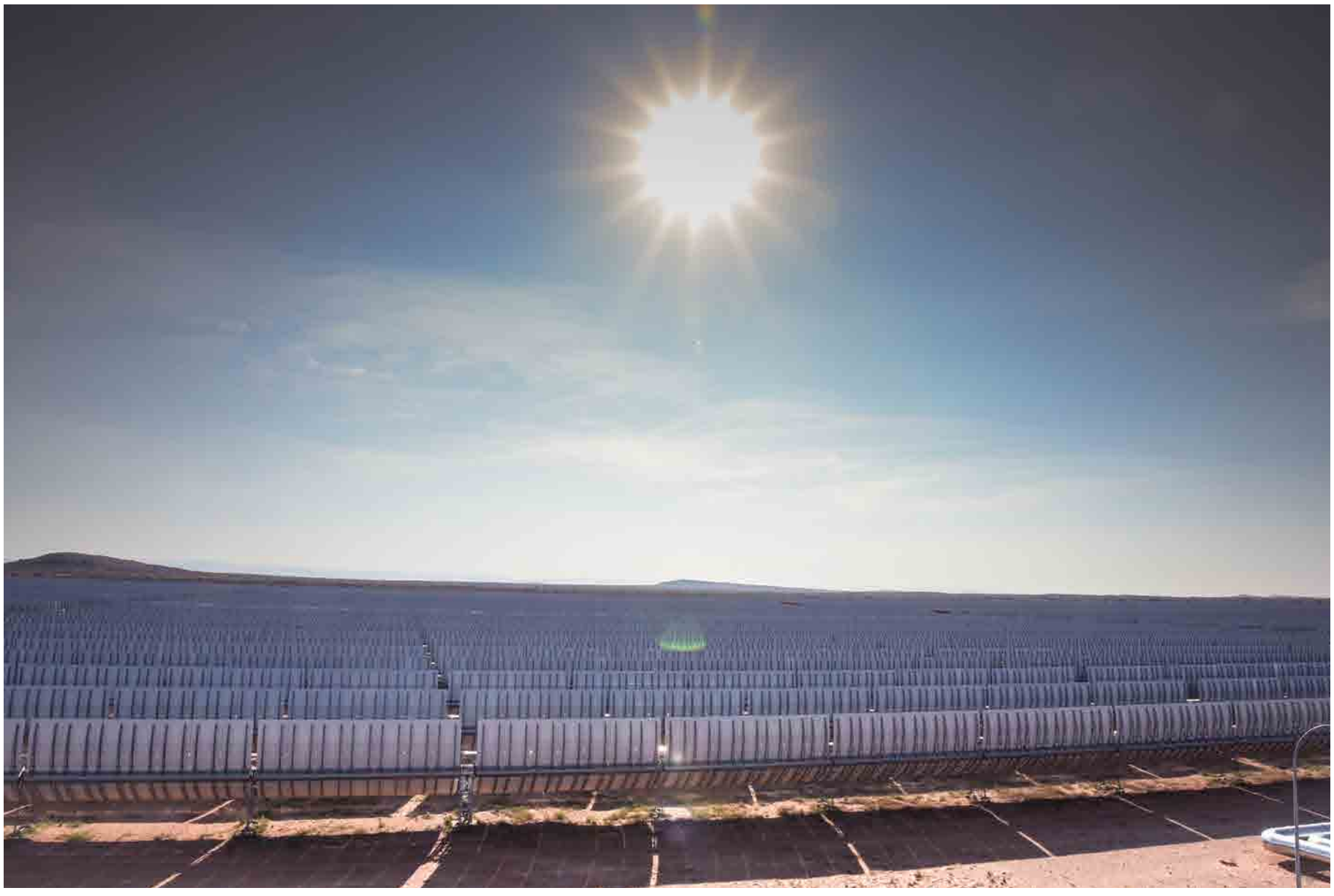
*Touwsrivier Project (Photo provided by Pele Green Energy)*

*Tsitsikama Community Wind Farm (Photo: Christy Strever)*

Photo Essay: Bokpoort Concentrated Solar Plant

# A MELTING POT OF ENERGY

*250 hectares are covered in parabolic trough mirrors, all curved to focus the sun's rays on a central heat collector. Photo: Christy Strever*



*The mirrors face the sun all day and have motors to move them to track it. Photo: Christy Strever*

*In the central plant the heat from the oil circulated around the mirrors is used to create high pressurised steam and to charge up the storage tanks of melted salt. The steam drives the 50MW turbine and the salt is stored to be used at night to carry on heating steam. Photo: Christy Strever*

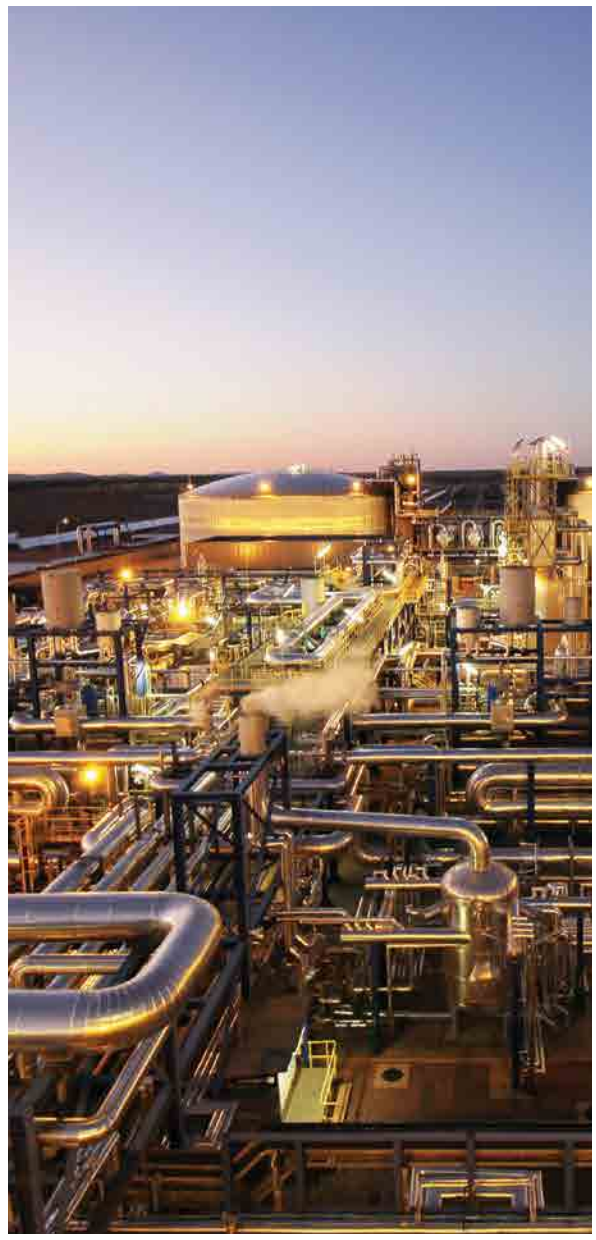
**IT IS FAR FROM ANYWHERE – A THREE HOUR DRIVE WEST OF KIMBERLEY IN THE NORTHERN CAPE OR 90 MINUTES FROM UPINGTON – BUT THE BOKPOORT CONCENTRATED SOLAR PLANT (CSP) IS WORTH THE EFFORT TO GET TO.**

It is epic in its scale, with parabolic trough mirrors covering 250 hectares of land to capture the sun's energy. It works by focusing the sun's rays onto an element that collects heat and runs along the length of a curved mirror. Inside the collector is a special oil that circulates around the Solar Field collector plates, heating up to 393ºC. At the central plant, that heat is used either to heat steam or to melt salt. The pressurised steam drives a turbine that generates 50MW of electricity. The molten salt is stored in two enormous insulated tanks and used at night to carry on heating the steam that drives the turbine. Remarkably, the plant has the capacity to charge up and store enough molten salt to keep the generator going at near full capacity for 9.3 hours after sunset, the largest storage capacity in Africa. That means it is able to supply electricity for 24 hours a day and in March set a record for continuously supplying electricity without interruption for almost seven days.

The operator and largest shareholder is Saudi Arabian utility company ACWA.

| Key Facts | |
|---|---|
| Location: | 113km South-East of Upington, Northern Cape |
| Energy produced: | 50MW |
| Site area: | 300 hectares |
| Start of full operations: | February 2016 |
| Technology: | Concentrated solar power, trough |
| Project cost: | R5bn |
| REIPPP window: | 2 |
| Owner: | ACWA 40%, Public Investment Corporation 25%, Lereko Solafrica Investment 13%, Lereko Metier Solafrica Fund 1 9%, Lereko Metier Sustainable Capital Fund 3%, Kurisani Solafrica Investments 5%, Solafrica Community Investment Company 5%. |

*In the central heat collector element is a high temperature oil that absorbs the sun's heat, reaching 393ºC as it circulates around the mirrors. Photo: Christy Strever*



*At night molten salts that have been stored in two tanks, seen in the photograph just meeting the horizon, is used to carry on producing steam to drive the turbine, enabling it to continue production for 24 hours a day. Photo: Nandu Bhula*

# DBSA'S RENEWABLE ENERGY LEGACY STILL TO UNFOLD

*KaXu Solar One, near Pofadder in the Northern Cape, has a total installed capacity of 100MW plus 2.5 hours of storage in molten salts. The plant started operating in early 2015 and produces enough clean electricity to power 80 000 households. Photo: DBSA*

Having committed financing support to 22 projects under the Department of Energy's renewable energy programme, the Development Bank of Southern Africa (DBSA) played a pivotal role in contributing to its success, in line with its mandate to drive infrastructure development and accelerate socioeconomic development.

The Renewable Energy Independent Power Producers Procurement Programme (REIPPPP), as it is officially known, has been lauded far and wide as one of SA's most successful public-private partnership programmes. And rightfully so.

Apart from the considerable long-term benefits of contributing 6,327MW of zero-carbon energy to the electricity grid, the programme has demonstrated that the country is a viable and reliable destination for international and local consortia willing to participate in infrastructure projects.

"This is something that we've been very passionate about and it's been a huge success," says Lucy Chege, DBSA's general manager for energy financing. "Before we started this programme, the local market didn't have expertise in renewable energy project financing. But we now understand the specific project financing issues and how to undertake due diligence and analysis of renewable energy projects, and we are sharing that knowledge with other counterparts."

She emphasises the theme of partnerships in the programme's outcomes, and it is for this reason that the DBSA does not claim sole responsibility for its success.

According to National Treasury, 92 projects had been selected by October 2015 to participate in the programme, attracting R193bn in private sector investment. Of this number, 28% is foreign investment.

The DBSA has committed funding to Independent Power Producer (IPP) projects with a total capacity of 2,512MW, of which 1,507 MW relates to projects under the REIPPP and 1,005MW under the Department of Energy's IPP Peakers projects.

The Bank has been intimately involved in the programme from before it was officially launched in 2011. This is through its collaboration with the Department of Energy and National Treasury to set up the programme and the Independent Power Producer (IPP) Office. This entity has been responsible for designing and managing all aspects of the REIPPPP, particularly the structuring of agreements between the government, Eskom, IPPs and commercial parties and their empowerment partners

This was a challenging enough undertaking on a purely technical level, with many softer issues further complicating SA's largest and most ambitious infrastructure investment.

Chege says one of the important lessons that DBSA has taken from the programme and processes over the past five years is the importance of working closely with many different partners and stakeholders. "All of our partners have different requirements and different perspectives, so we have always tried to develop alignment and synergies between these partners and stakeholders. Especially at the beginning, we would not have been able to do this without having those partnerships and their commitment to making it work. For us it was new technologies and for them it was a new country, so we had to help each other to understand either the technologies or local dynamics.

"This is a common theme across the renewables programme, whereby really good partnerships have been formed because if people are not working together we would not be able to achieve the desired goals and objectives."

At the heart of the DBSA's involvement as a development finance institution is its ability to provide financing for infrastructure programmes such as this. Due to the nature and structure of REIPPPP this was not a straightforward matter.

For instance, apart from providing finance for the project itself, the bank financed the equity contribution for the project sponsors' BEE partners, as well as the local community to enable them to subscribe for their equity

*Workers conduct cleaning and maintenance work at the 96MW Jesper Solar Photovoltaic Power Plant in the Northern Cape.*

stakes in the project.

This last element was one that had never been attempted before and required considerable effort to pull off. And even though funding of BEE shareholding had been undertaken before, the scale of the project and financing involved was new territory for Chege's unit.

"This has helped us to refine the model of BEE financing quite a lot," she says.

With approximately R1.5bn provided to BEE groups and local community trusts under the REIPPPP, this is not an insignificant contribution, although it is but a fraction of the approximately R14bn committed thus far in project finance to the renewable projects.

While the scale of the project financing might have been within the bounds of the bank's previous experience of funding infrastructure programmes, the novelty of new technologies was a different matter.

"We had to gain knowledge through training and involving experts who had global experience from similar projects," Chege explains. "It was a steep learning curve in the beginning, but it was a very good experience and the country can now say it is one of the leaders in the renewable energy industry, particularly in Africa."

The Africa angle is important as sub-Saharan Africa's infrastructure development falls squarely within the DBSA's mandate. This involvement places the bank's experience in public-private partnership financing through REIPPPP into perspective as it will undoubtedly be able to contribute that expertise to major infrastructure projects across sub-Saharan Africa.

The DBSA has financed numerous gas-fired power plants and infrastructure projects across the continent as part of regional integration efforts to address the continent's power deficit, with notable projects including Cenpower, the Ghana powership project and the Bulk Oil Storage Terminal in Ghana.

The involvement of communities through local trusts and ensuring their part-ownership of these projects is undoubtedly one legacy the renewable energy programme will proudly leave behind.

The way communities have been guaranteed ownership and long-term financial flows from these projects is an aspect that excites Mpho Mokwele most. He is a manager within DBSA's energy unit who has been involved in the structuring and financing of community trusts to ensure they receive the benefits due to them. "From my point of view, apart from the clean energy perspective, a key highlight for me was making sure the projects involved local communities in and around the projects," he says.

Ownership in the projects through community trusts that were set up to house the shares is but one of the ways in which benefits flow under the REIPPPP. Project owners have also made commitments to promote socioeconomic and local economic development.

"The communities don't want to wait for 10 years before seeing the benefits from the projects, so we are ensuring that the people see the benefits by accelerating development in those communities," he says.

This is an imperative as, although renewable energy projects are able to reach operational readiness rather quickly, the cash flows from dividends are not immediately forthcoming.

Mokwele says the DBSA is looking at ways to ensure the expectations of local communities are met through the implementation of various financing mechanisms that are under consideration at the bank. "Commercial banks would tend to look at their return on investment, but the highlight for me as an officer of a development finance institution is that the project ensures local community development," he says.

As has Chege noted, these are important lessons that the DBSA is able to use in other infrastructure projects it funds, and to share with its partners within and outside the country's borders.

Mokwele says the lessons from the renewable energy programme could easily be applied to other infrastructure projects such as transport and water.

"We are trying to replicate the programme-type approach used in REIPPPP to ensure that infrastructure can be rolled out on a massive scale. Going forward we would like to replicate this into other sectors in SA and are also working on a similar REIPPPP model outside SA to help countries like Botswana to roll out an IPP programme."

The experience and lessons picked up as a result of the REIPPPP cannot be denied. One measure of the value to the country will be how well that knowledge informs future infrastructure projects.

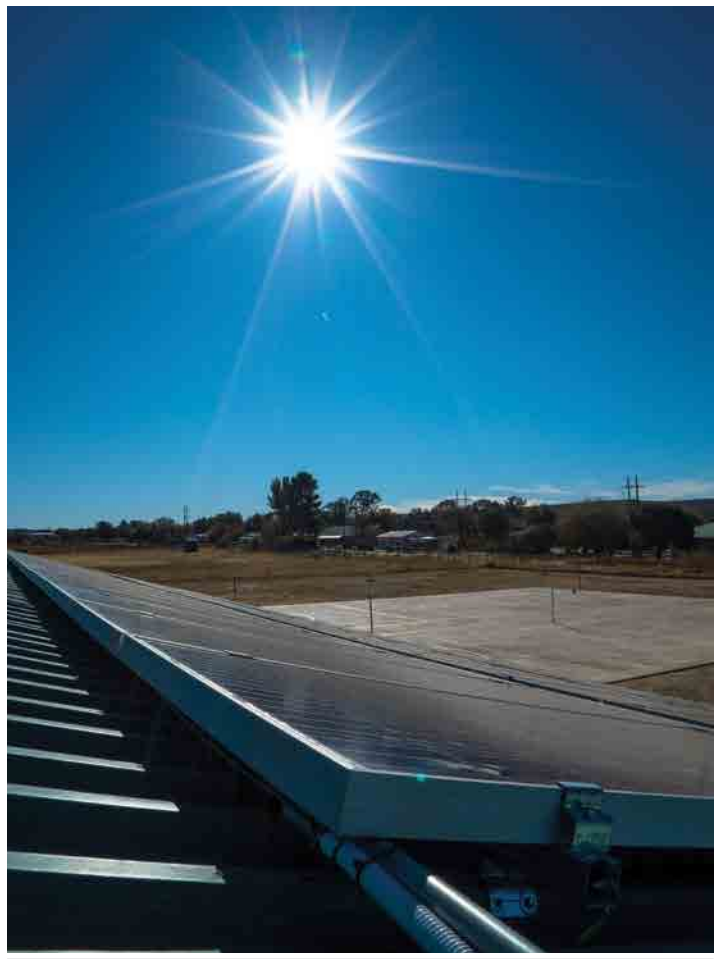
DBSA business development professional Tsitsi Musasike says it is essential that these lessons be shared, particularly in the context of the developmental impact of such infrastructure projects.

More importantly, the success of the REIPPPP has invigorated DBSA's appetite for undertaking more projects of the same nature, or those in other sectors. "A lot still needs to be done in the country and the rest of continent if we are going to achieve higher economic growth and catch up with the developed world," she says.

In the immediate future, DBSA already has its eyes on participating in the recently announced programme to produce power from liquefied natural gas, where plants will be developed at Richards Bay and Coega.

"The REIPPP programme is unique in that it is clean energy and generated a lot of excitement. I expect we will see the same high levels of excitement as we saw with REIPPP and a lot of international players under this programme," she says.

The benefits of having been so involved in the renewable energy programme can therefore be expected to be brought to bear on gas-to-power programme. Some of these benefits include applying due diligence and analysis experience, project assessment and management skills and drawing on partnerships to ensure the long term success of such a major undertaking.



*The sun reflects off a solar panel at the Jesper PV Power Plant. The consortium of Solar Reserve, Kensani and Intikon Energy was awarded the Jasper project in the second round of the bidding.*

Chege says that the three main technologies applied in the renewables programme — wind, photovoltaic (PV) solar and concentrated solar (CSP) — are each very different, requiring different success factors.

"We have come to a point now where we know how to assess a wind project. These projects can be fairly challenging to assess accurately due to the potential variability in output. You have to look at many technical aspects and assumptions to understand and conclude whether it will produce sufficient power over the projected period.

"With PV power, on the other hand, given that the country has significant solar resources, it is easier to determine with a higher level of confidence how much power will be produced."

The experience gained from understanding the complexities of concentrated solar projects is one that excites Chege. These projects tend to allow for much higher energy production projects and are able to feed into the grid after dark due to the thermal energy storage capabilities.

The DBSA's legacy in terms of infrastructure development could easily be overshadowed by the outstanding success of the REIPPPP, but that would be at the cost of recognising the work it does in helping to build more modest but equally essential infrastructure.

The bank's role in building capacity and infrastructure, however, can certainly be enhanced by applying the lessons it has learnt from the renewable energy programme. The physical infrastructure, the lower carbon footprint and the benefits to local communities will be evident for all to see for many years to come. But the true measure of this programme's success will be in the untold stories of mega infrastructure projects that have been able to apply the methodologies and principles developed in getting REIPPPP off the ground successfully. It is also a resounding success for public-private partnerships that will serve the continent well in the face of its substantial infrastructure deficit. ■

DBSA
Development Bank of Southern Africa

Photo Essay: Solar Capital De Aar photovoltaic plants

# A CARPET OF SOLAR

*On the ground among the panels at De Aar 1. Photo: Supplied by Solar Capital*

**DE AAR IN THE NORTHERN CAPE IS A HOT SPOT OF PHOTOVOLTAIC PROJECTS. THE TWO BIGGEST PHOTOVOLTAIC DEVELOPMENTS IN THE COUNTRY SO FAR HAVE BEEN DEVELOPED THERE BY SOLAR CAPITAL, WITH A COMBINED CAPACITY OF 175MW.**

De Aar's claim to fame used to be that it was a major shunting yard for Transnet but now it has been put on the map for its photovoltaic energy generation. The climate boasts high sun radiation and relatively clear air, ensuring maximum penetration to the solar cells on the ground.

The two plants together add up to the largest photovoltaic operation in the Southern Hemisphere and Africa. De Aar 1 was among the first plants to come online in the REIPPP programme, becoming fully operational in August 2014. De Aar 3 joined the grid in March 2016. A project for De Aar 2 has been conceptualised but has not yet been chosen in the REIPPP bidding rounds.

In a sense, photovoltaic is the simplest technology to use because panels can be connected together to increase capacity. The panels themselves generate the energy so no further turbines or other infrastructure is needed, apart from the transformers and inverters (which change direct current into alternating current) and the switches and wires to connect them.

De Aar 1 has 203,000 panels across 282 hectares which all connect to generate the 75MW that it contributes to the Eskom grid at peak times during the day. In fact, the plant can generate more and has to shed some of its capacity in order not to go over the limit.

The downside of photovoltaic electricity is that it is not available at night. But dramatic declines in the cost of producing photovoltaic plates means it is now among the cheapest possible sources of electricity during the day. With extensive research and development under way in battery technology, soon it may be cost effective to store the electricity generated for use at night. Solar Capital has invested in a Korean battery company with a view to developing such technology.

| Key Facts | |
|---|---|
| Location: | De Aar, Northern Cape |
| Energy produced: | De Aar 1: 85MW<br>De Aar 3: 90MW |
| Site area: | De Aar 1: 280 hectares<br>De Aar 3: 191 hectares |
| Start of full operations: | De Aar 1: August 2014<br>De Aar 3: April 2016 |
| Technology: | Photovoltaic cells |
| Project cost: | De Aar 1: not disclosed<br>De Aar 3: not disclosed |
| REIPPP round: | De Aar 1: 1<br>De Aar 3: 2 |
| Owner: | Solar Capital and others |

*A closer look at De Aar 1. Photo: Christy Strever*

*In the foreground is Solar Capital De Aar 3, covering 191 hectares, and in the distance behind it is De Aar 1, covering 282 hectares. Between them they generate 175MW of electricity. Photo: Christy Strever*

*Among the panels at De Aar 3. Photo: Supplied by Solar Capital*

The Entrepreneurs

# SA YOUNGSTERS MAKE GOOD

*A key objective of the IPP programme was to stimulate new businesses in South Africa. Here we look at two companies that have sprung onto the global stage on the back of the IPP programme.*

***Stuart Theobald***

## PELE GREEN ENERGY

### *From garage start-up to aspirant pan-African utility company*

When five young professionals in their 20s quit their corporate jobs in 2008 to become entrepreneurs, they had no idea they would become full-scale developers of renewable energy projects just five years later.

With two friends on a holiday to Europe, Obakeng Moloabi, then an interest rates derivative trader at Standard Bank, used some South African contacts to organise a visit to renewable energy projects and gain insight into how that market had developed.

"There was a lot of interest on our side because of load shedding. We understood through a little research what the policy intention of the SA government was in relation to power generation and the power sector in general," he says. Believing that the government was going to move towards more private sector involvement in generation and with an ambition to contribute to youth development, he and four other young professionals teamed up to launch Pele Green Energy.

It was a typical start-up story, with their first office in a garage at Moloabi's sister's house in Roodepoort. "People say you watch too many Silicon Valley stories," says Moloabi now. "But this was real. That's where our office was, in a garage."

Their first project was a landfill gas-to-power plant that would be designed in terms of the United Nations Carbon Credit initiative. In 2009 it was probably the only renewable technology that was well enough priced

*" This was real. That's where our office was, in a garage."*

*Clockwise from top left: Gqi Raoleka, Fumani Mthembi, Boipelo Moloabi, Thapelo Motlogeloa, Obakeng Moloabi. Photo: Christy Strever*

to be somewhat competitive. But then 2011 and the REIPPP programme came about. The Pele team parked their landfill gas-to-power project and started concentrating on solar and wind. They partnered up with French solar company Soitec to develop a 36 megawatt plant based on concentrated solar photovoltaic, a technology that uses magnifying glasses to focus the sun onto photovoltaic chips. Preparing the bid was a frantic affair and the team managed to get their documents through the gates of the assessment centre with only two minutes to spare.

The announcement came a month later, when the minister addressed the 17th Congress of Parties conference in Durban. Moloabi had been at the event but had left the day before the announcement, so he had one of his former colleagues from Standard Bank report back on the happenings. "He took a picture of the projects as they were announced and sent it on Blackberry messenger. When we saw that, literally we were screaming. We had a party, I went to bed the next morning at 4 o'clock. It was incredible."

And the announcement was not a moment too soon for the fledgling company. "At that time we had been operational for just over two years, and the money was running out that we had saved from our corporate lives and it was like this idea needed to have happened then or we would have probably all had to go back to our corporate jobs. So that day was a day of relief."

But the team had no time to waste to pull the project together for financial close. It also prepared to submit bids for round two of the programme, but that, it would turn out, would be less successful. "Round two stands as a sad point in Pele's life," says Moloabi. "We mispriced it. It's the only round we haven't been successful in, but we learnt fantastic lessons about what we had to do to improve our competitiveness, how we had to pick our partners, what the considerations needed to be." The team decided that rather than just be funders and owners of projects, they needed to participate in other parts of the value chain including construction and operations in order to be able to blend the returns and ultimately bid at lower prices.

In round three, Pele teamed up with Italian utility Enel to bid on an 88MW wind farm. It also bid as part of the construction and operating consortia on two solar plants with another Italian firm, one in the Western Cape and one in Limpopo. "These companies came from Italy and don't know the local market. So we were really their partner for procurement locally, and looked after their economic development promises," says Moloabi.

The company also joined bids in round 3.5, a round held specifically for concentrated solar plants. In that case it bid as part of an ownership consortium for the 100MW Redstone CSP plant. Given the massive capital expenditure required for tower-based CSP plants, it took just a small stake.

Round four was the biggest for the company, when it won four out of five bids that it submitted. Three were 140MW wind plants with Enel, taking a 30% interest in each and a subcontractor role in the operations. In the fourth, it partnered with Spanish firm Gestamp for a 100MW wind farm, and took a role across the value chain including ownership, construction

management and operations.

In the last round that has been conducted, known as round 4.5 or the "expedited round", Pele bid on an unprecedented 10 projects. One of those it has fully developed itself, taking the driving seat on a project for the first time. "It's the first one where our entire suite of capabilities, engineering, procurement, construction management, asset management, is all encompassed," says Moloabi.

So in just five years, Pele has gone from a participant at the ownership level to a developer in its own right. It is also going international – it has invested in a natural gas plant in Mozambique and is bidding with partners on new solar plants in Ethiopia and Senegal. It is also looking at acquisitions in other markets.

The company has swollen to 20 people, including engineers and operations experts to complement the financial strengths of the founders. The average age is only 29.

"I already feel that some of our dreams are being achieved, although this is only the beginning," says Moloabi. So where will it be in five years' time? "Five years ago I couldn't have imagined this. I can only say what I want the business to become. When the legislation comes into play and opens up this market, we want to be a utility that can compete well across the African continent. In our view there is scope to build another four or five Eskoms in Africa." Maybe one of those will have the IPP programme to thank for sparking it to life. ■

*Paschal Phelan at Solar Capital De Aar 3. Photo: Supplied by Solar Capital*

## SOLAR CAPITAL

### *From De Aar comes the third cheapest solar developer in the world*

After building up a giant food manufacturing and meat export company in Ireland, Pascal Phelan decided he was sick of the weather. So he packed up and retired to Cape Town in 2002.

Retirement, however, did not go so well. The ever-restless Phelan got into property development. Then load shedding struck in 2007. Phelan owned a game farm in the Karoo and at about the same time, Eskom announced it was building a substation nearby. "The local farmers wanted to object, but I thought hang on, the wind blows like heck and the sun's always shining, maybe there's an opportunity here," he says. So he hired a contact who was keen to leave his banking job and gave him the task of finding out about renewable energy. "At that stage I couldn't spell the word 'renewable'," he says.

He did some research and noted the declining cost of solar photovoltaic cells. He also considered wind but decided PV was lower risk. "It's easy, point the thing at the sun and light the bulb at the back."

His team studied solar radiation across South Africa, and overlaid a map of where Eskom's substations were located. They then started buying up farms near the substations, which meant future photovoltaic plants could connect to the grid cheaply. At that stage he had no idea anyone was going buy any electricity. "It was only that the logic worked," he says.

When the IPP programme came out, it was all systems go. "We put a team of six or seven together and we worked the detail day and night. On the morning of the bid we finished at 4.30 in the morning. We had 16,000 pages. We'd done it."

But it almost went all wrong. A week before the bid a major bank called Phelan to a meeting in Sandton and told him its credit committee had blocked their funding contribution. On the same day, an international partner declared that it was no longer interested in only taking a minority stake and wanted to force Solar Capital's stake from 30% to 10%. "So we said no. This is our project, we invited you in, and that's not going to happen. I phoned the office on the way to the airport and said I'm coming, we've got a major hole, let's have some options by the time I hit Cape Town."

By the time he got there his team had put together a list of other companies who had expressed an interest. They decided on an Italian company. "I phoned them on a Thursday afternoon and said listen, an opportunity has come up. And they said right, we'll be in Cape Town by Saturday morning. By Monday afternoon, we had a complete deal done. And they backed the bid and we didn't need the bank."

When the bid was announced, Phelan had been speaking at COP 17 but wasn't aware the announcement had happened. "Then people were slapping our backs and taking photographs. So the four of us went out to the Oyster Box Hotel in Umhlanga for lunch. Put it this way, at dinner time they suggested we move inside to the bar because the singing was a bit loud. Four other people had joined us, and even for a moment Charlize Theron was sitting at the next table and clapping us on. So we celebrated with a wee bit of style."

But they didn't pause for long. Solar Capital submitted two more bids in round two, one of which was successful. The firm then went ahead and constructed the two plants, Solar Capital De Aar 1 and Solar Capital De Aar 3 which are next to each other and connected to the same substation (see page 24). They are contracted to supply 150MW between them, but have a nameplate capacity of 175MW, making them the biggest solar photovoltaic plant in the southern hemisphere and Africa.

Phelan didn't start small for a first-time developer. "I took the view that if you can build 1MW of this thing, then 75MW is just 75 of the same thing. And we built it, and I'm telling you it is like that."

That foundation has now put Solar Capital onto the world stage. "We have learned our trade in South Africa. We're now using that South African team and experience to grow overseas. At the moment we're involved in projects in six different countries," says Phelan, with the aim of becoming the lowest cost producer in the world.

When I met him in in September, the firm was feverishly preparing a bid for a 350MW plant in Abu Dhabi. Weeks later Abu Dhabi announced a new world record price, having accepted a bid of 2.42 US cents per kilowatt hour from a Japanese-Chinese consortium. Phelan Energy, however, placed third with a bid of 2.59 c/kWh, which was considerably lower than the previous world record of 2.91 c/kWh set a month earlier in Chile. So the IPP programme has helped create the third cheapest solar developer in the world.

Phelan has many other ambitions. He has invested in a Korean lithium ion battery manufacturer and is moving towards battery storage as a way of making photovoltaic a 24-hour source of energy. He says battery prices are following a similar curve as photovoltaic module prices, falling significantly as volumes grow.

He believes that photovoltaic plants could now be made 24-hour at a capital cost only 20% higher than the standard plants. And he believes that South Africa could become the site of major manufacturing of solar panels, even beating the Chinese on cost.

Ultimately, he argues, South Africa can become a much cheaper energy producer that would then stimulate the reindustrialisation of the country which in turn would generate many jobs. All, of course, contingent on there being the political will to make it happen. ■

Technology

# THE SCIENCE BEHIND RENEWABALE ENERGY

*The South African REIPPP programme has drawn on many different technologies, some of which have been significantly developed just for application in the programme. Here, Steven Hawes explains the science and workings of some key renewable energies.*

## SOLAR PHOTOVOLTAIC

Solar photovoltaic (PV) systems use cells to convert sunlight into electricity. The PV cell consists of one or two layers of a semi-conducting material, usually silicon. When light shines on the cell it creates an electric field across the layers causing electricity to flow. The greater the intensity of the light, the greater the flow of electricity. PV plants generally have a capacity factor of 25% – 30%.

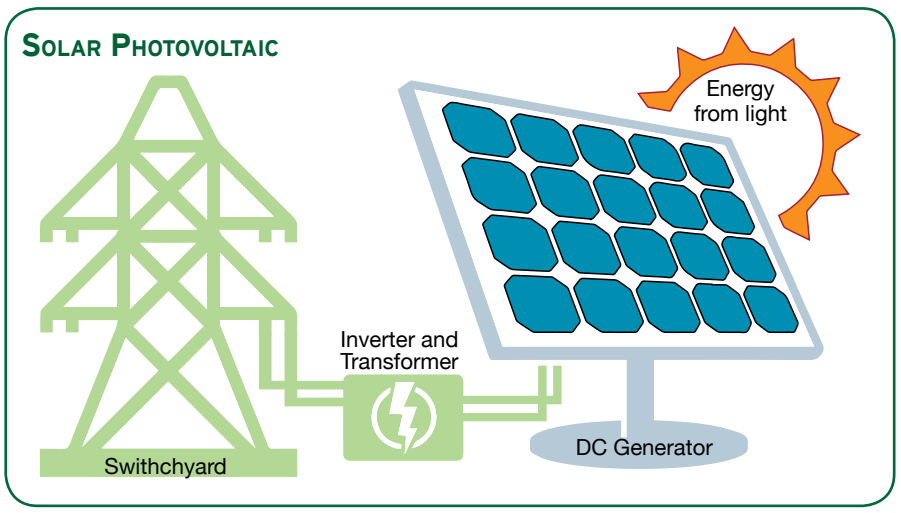
There are 3 main types of PV module in use in the REIPP. These are: monocrystalline silicon, polycrystalline silicon and thin-film PV.

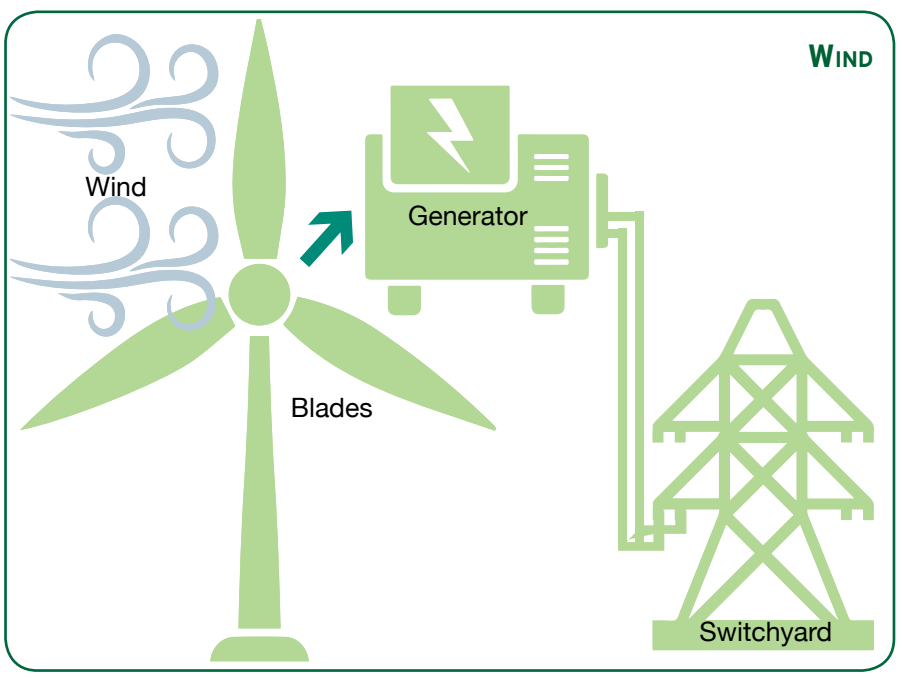
The solar cell is the basic building block of PV technology. Most people are familiar with PV solar cells in some form, such as those that power calculators or small batteries. These cells are wired together to form a PV module (sometimes referred to as a solar panel). PV solar cells are referred to in terms of the amount of energy they generate in full sunlight, known as "kilowatt peak" or KWp. Large numbers of modules in a solar array are measured in terms of "megawatt peak" or MWp.

The PV modules are arranged into an optimal array in order to gather the maximum amount of solar energy and convert it into direct current (DC) electricity. It is possible to mount the modules on a fixed structure or on a moving structure that angles the modules to harness the maximum amount of solar energy over the course of the day.

An inverter can convert this DC power into alternating current, also known as AC power, which is the type of electricity used in your home. This power undergoes a voltage step-up through transformers in order to ready it for efficient transmission over the electricity transmission grid.

In SA the systems that have been developed as part of the REIPPPP are utility-scale systems. These range from 5MW to more than 90MW (DC MWp) in size, per project site, although the maximum contracted capacity for PV is 75MW. Systems that are larger than this rely on some redundancy in order to continuously meet the 75MW output target in order to maximise the revenue earned by the project.




## ONSHORE WIND

Wind is caused by temperature and pressure differentials in the atmosphere and contains kinetic energy. Kinetic energy is essentially the possession of energy by a body of matter due to that body being in motion. When air is in motion, the wind blows towards the turbine's rotor blades, causing them to spin around, capturing some of the kinetic energy. The rotor blades are attached to a drive shaft which turns due to the movement of the rotors. The towers on which the turbine and blades are located can be up to 120m high. The rotor blades vary in length, depending on the prevailing conditions, but can reach lengths of 70m in very large turbines. The capacity factor of wind turbines varies according to the weather patterns and quality of wind, but averages out at approximately 30% for onshore wind in South Africa.

In order to regulate the speed of rotation, the rotor blades can swivel on the hub at the front so they connect with the wind at the best angle for generating energy. This is called "pitch control" and on large, utility scale wind farms, this control is automated by sophisticated control mechanisms.

Anemometers (which measure wind speed) and wind vanes on the back of the nacelle (the box holding the turbine at the top of the mast) measure the speed and direction of the wind. Using this data, the nacelle and rotors are rotated horizontally using a yaw motor. This allows the turbine to face into the wind in order to maximise the capture of kinetic energy, no matter which direction the wind is blowing from. The anemometers also allow for safety precautions, such as the

### JARGON BUSTER: CAPACITY FACTORS

The capacity factor of a power plant is the ratio of its actual output to its potential output (over a specific period of time) if it were possible for it to continuously produce power at full capacity (also known as "nameplate capacity"). The capacity factor is calculated by taking the total amount of energy the plant produced over a defined period of time and divide that amount by the amount of energy the plant would have produced at nameplate capacity.

This is an important calculation as it enables effective comparison of various generation technologies. In addition, specifically in the context of renewable energy, capacity factors are dependent on the resource available over time and are therefore the subject of much debate. The design of the plant also contributes to the capacity factor. It is important to not confuse capacity factor with efficiency, which is a measurement of how efficiently energy is converted to electricity.

### WHAT ABOUT BATTERIES?

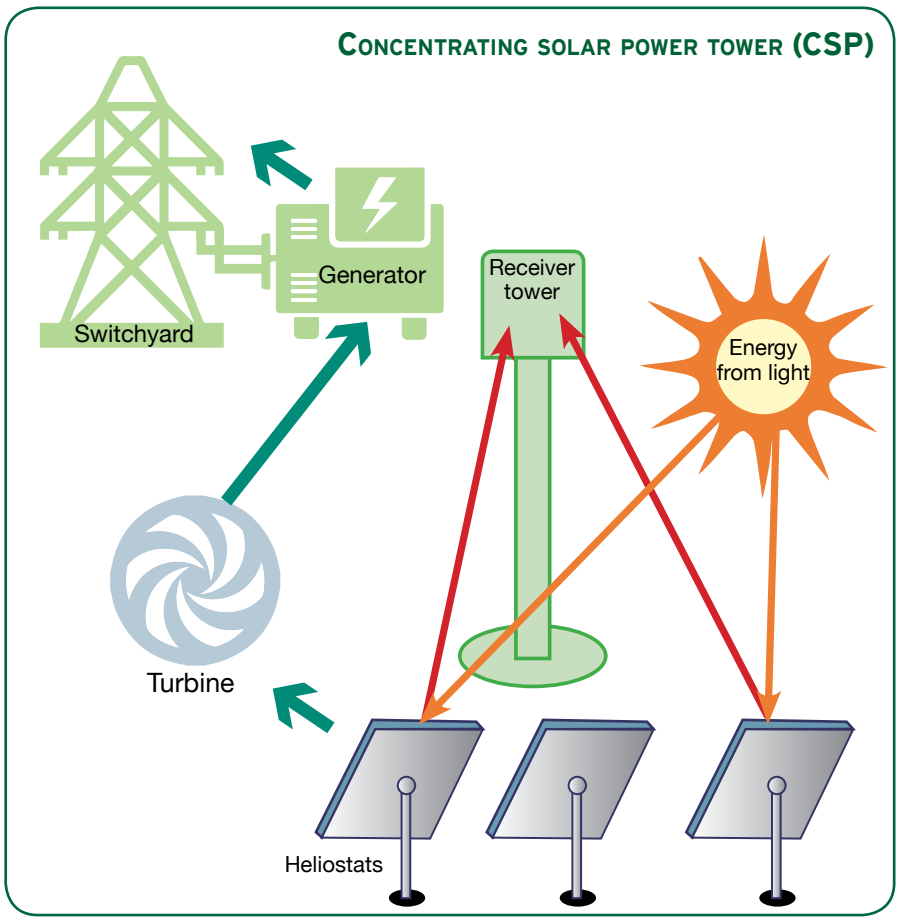
The creation of large-scale batteries for the storage of electrical energy is a very active area of research. Many advocates of renewable energy generation see the storage of such energy as an important part of a transition to a renewables-dominated future. Battery prices have been coming down and new developments may well accelerate this. As things stand, though, the technology is prohibitively expensive for utility-scale deployment. The economics of storage shift if negative externalities of lost power or environmental impacts of conventional generation are factored in. It is not hard to imagine a future in which the price of storage comes down to levels clearly below the true cost of non-renewable baseload generation when the costs of environmental impact are factored in.

application of braking on the rotors and drive shaft if the wind speed is too high.

The nacelle contains a gearbox that increases the low speed rotation of the drive shaft into high speed rotation in order to drive a generator of a specific capacity (usually 2MW – 3MW in large turbines) efficiently. This gearbox can increase the speed of the rotation by a factor of 100 or even more. Many blades rotate at a maximum speed of 15 revolutions per minute, which can be geared up to 1,500 revolutions per minute. This process is the final step in the harvesting of kinetic energy from the wind.

The generator, which is situated behind the gearbox in the nacelle, uses this kinetic energy and turns it into electrical energy via a process known as electromagnetic induction. The electric current produced by the generator flows through a cable running down through the inside of the turbine tower. A step-up transformer converts the electricity to higher voltage for efficient transmission via the electricity grid.

## CONCENTRATING SOLAR POWER (CSP)




Concentrating Solar Power plants, or CSP plants, can be viewed as a hybrid of renewable energy and conventional thermal energy generation techniques. CSP plants utilise thermal energy from the sun to generate sufficient heat to drive conventional steam turbine generators, such as those found in coal-fired power plants. One important aspect of CSP plants is that the thermal energy concentrated in the plant can be stored in order to be utilised when it is needed, even when the sun is no longer shining. The capacity factor of CSP plants can reach up to 40% with enough storage, with some plants being able to run 24 hours a day for days at a time.

All CSP plants utilise mirrors to concentrate thermal energy, but there are different applications of this technology. Two primary technologies dominate the CSP field: parabolic trough systems and solar tower systems. These are both used in South Africa. There are other CSP technologies such as the Fresnel reflector and solar dish, but these are less common.

Parabolic trough systems use curved mirrors, in the shape of a trough, to focus the sun's energy onto a tube running over the center of the trough. These are called collectors and are arranged in large arrays called solar collector fields. These mirrors are mounted on a movable apparatus which can tilt the mirrors to maximise the concentration of the solar energy. The solar collector fields can contain hundreds of mirrors, depending on the size of the plant and its designed nameplate capacity.

Inside the tube is a high-temperature heat transfer fluid, such as a synthetic oil or molten salts, which absorb the sun's energy. These heat transfer fluids serve two purposes. First, the fluid is passed through a heat exchanger in order to heat water to drive a steam turbine. Second, the fluid stores solar energy in the form of heat. Some plants are equipped with storage tanks which can efficiently retain the heat in the fluid for later use in the same heat exchanger.

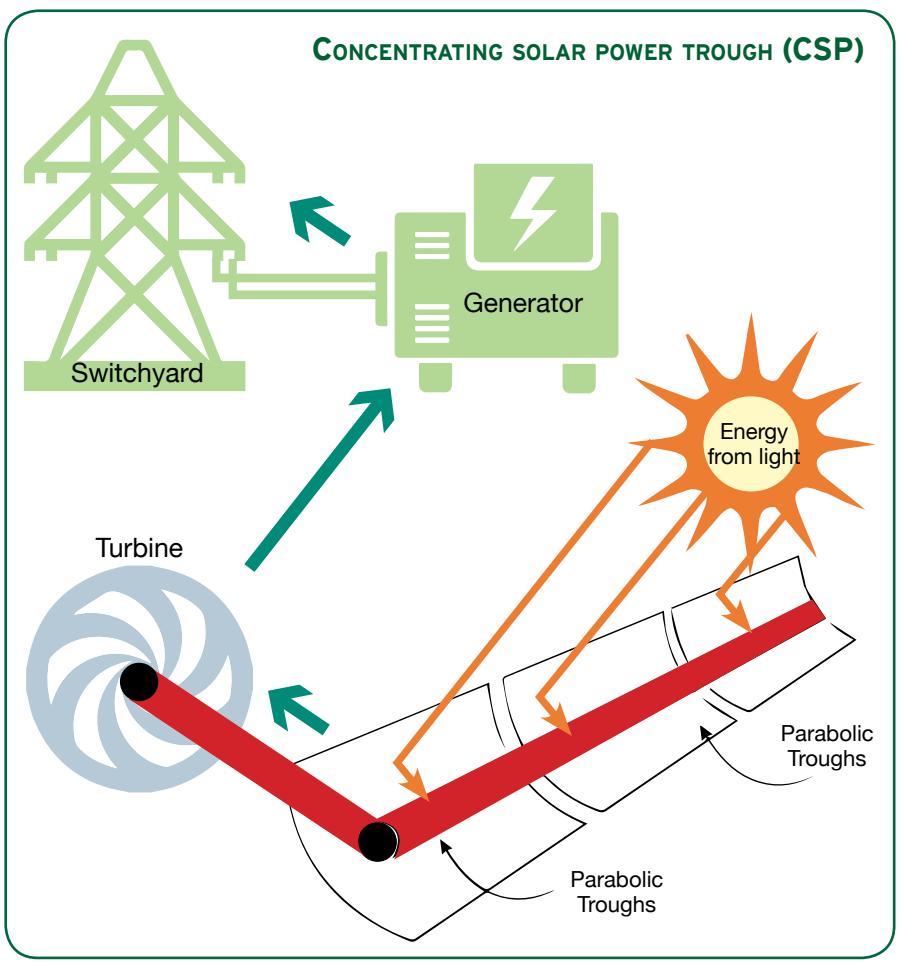
The steam created in a boiler from the heat harvested in the solar field drives a conventional steam turbine power system to generate electricity. A step-up transformer is utlised to increase the voltage of the electricity for efficient transmission.

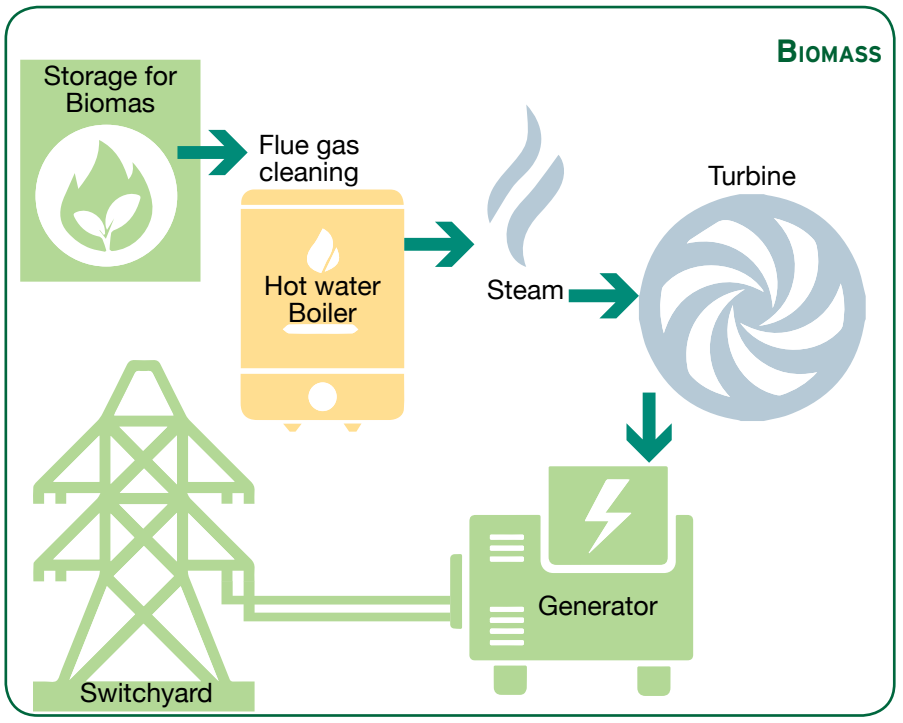
Solar Tower systems operate on a similar principle, but use a central receiver system, which allows for higher operating temperatures and thus greater efficiencies. Large arrays of flat mirrors (called heliostats), are directed by a computerised tracking system to track the sun along two axes and focus solar energy on a receiver at the top of a high tower. The heat transfer fluid in the tower can either be water which is vaporised into steam directly, or melted salts which is then used to create steam through a heat transfer system at the bottom of the tower. The steam drives a turbine generator.

## BIOMASS

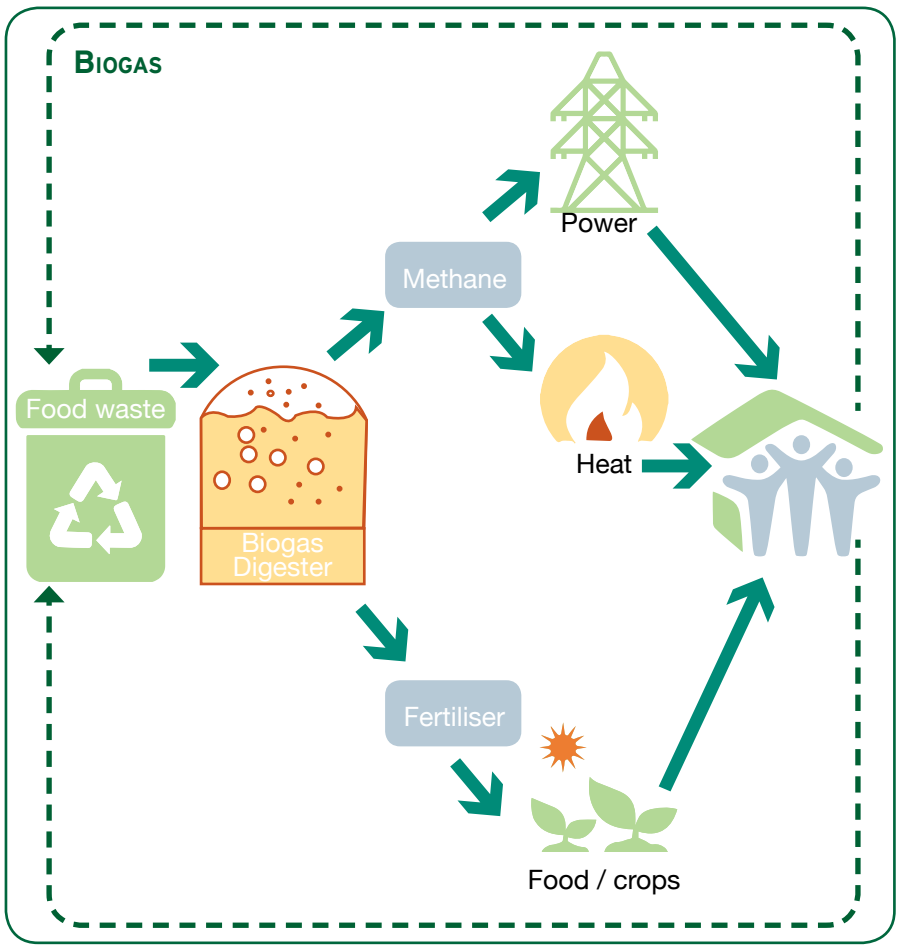
Biomass power generation is similar in nature to conventional coal-fired power generation in that it requires the burning of fuel (the biomass) in order to generate heat in a boiler system which drives steam turbine generators. The primary difference is that biomass plants can use a variety of biomass as fuel. These could be forestry by-products (such as wood chips), agriculture by-products (such as sugarcane bagasse) or other "energy crops" that are grown specially to be burnt in this way. The chemical composition, quality, source and availability of the biomass is fundamental to the successful operation of such a project and thus forms the most complex aspect of any biomass generation application. The capacity factor of a typical biomass plant varies between 40% and 70%, depending on a variety of issues, such as the quality and availability of biomass.

It is interesting to note that most biomass projects are what are known as




combined heat and power (CHP) projects because of their inherent attachment to other industrial facilities that provide the biomass required, such as sawmills, pulp plants or sugar mills. CHP projects produce electricity while simultaneously producing other products such as heat or steam which are useful in other industrial applications.




## BIOGAS

Biogas is the product of the digestion of organic material by bacteria to produce a flammable gas, consisting primarily of methane, carbon dioxide and a small quantity of water vapour. Biogas can be used to generate electricity by driving generators attached to gas-fired combustion engines. This power is able to be dispatched on the transmission grid after the voltage is stepped up. Biogas plants can have a capacity factor of 70% to 80% in ideal conditions.

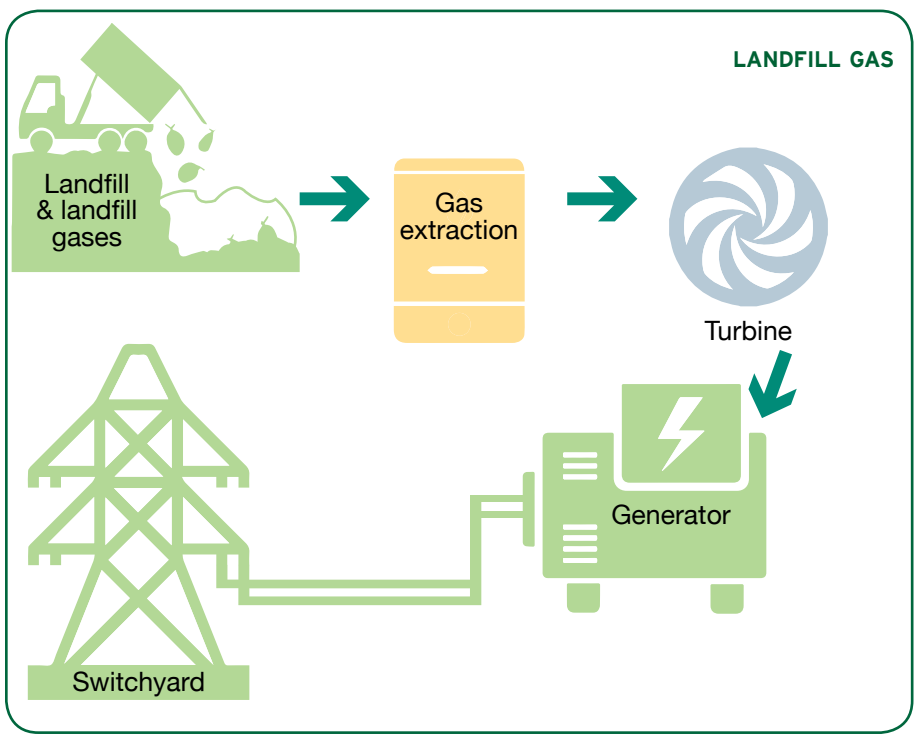
This allows for a variety of potential applications, albeit at smaller scale to other renewable energy technologies, as biogas can be used as fuel in nearly all types of combustion engines. The possible scale of the plant is limited by the gas supply and engine size.

The process of generating electricity from biogas is similar to conventional gas-fired generation, save for the difference in chemical properties of biogas as opposed to natural gas, petroleum gas or diesel. Biogas can also be used for cooking and heating applications, much the same as natural gas or petroleum gas.

The digestion process is the most critical to this form of renewable energy as the ready supply of biogas is critical to the effective and efficient functioning of this type of plant. The yield of biogas is influenced by feedstock, plant design, climate, fermentation temperature and retention time in the digester.

The digester is a large tank into which the organic material is placed in order to begin digestion. The introduction of bacteria begins this process. The types of organic material used can include: abattoir waste, chicken litter, pig sty slurry, manure, plant matter (such as algae, straw, grass or vegetable waste) and sewage.

Once the gas is produced in the digester, it must be tapped into a storage vessel prior to being utilised.



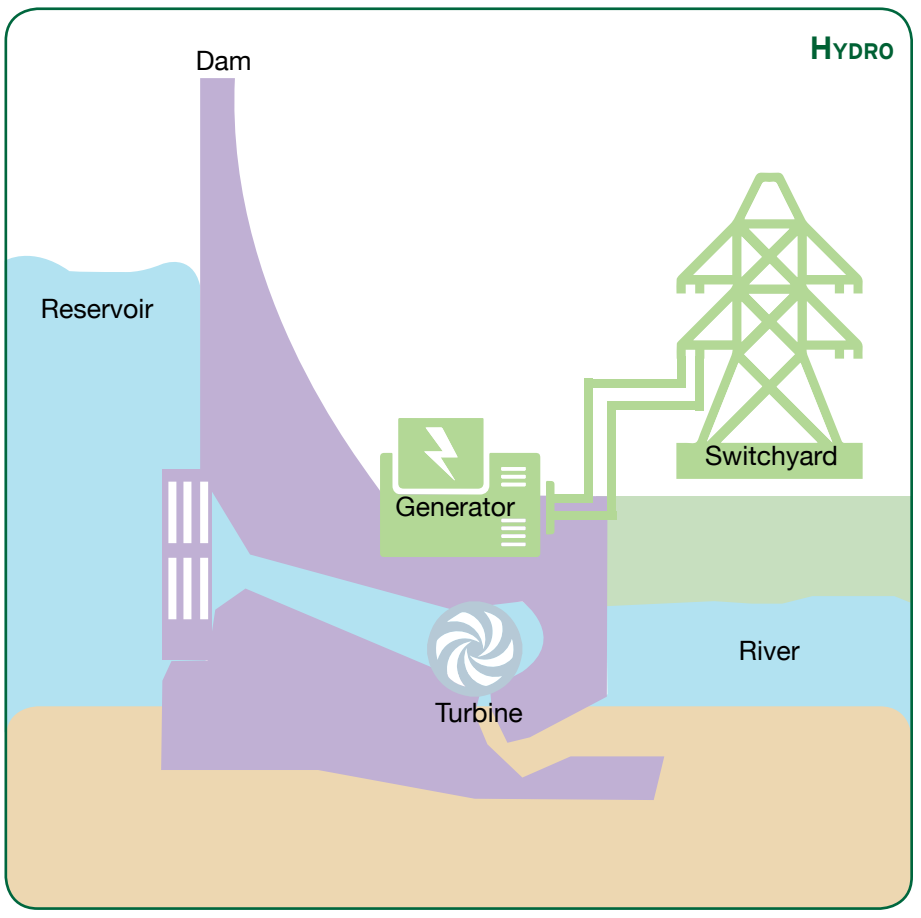

## LANDFILL GAS

The generation of electricity from landfill gas is similar to that of biogas, except that the gas is derived from a different source, namely landfill sites.

Landfill sites produce methane and carbon dioxide from the decomposition of organic matter. The gas is harvested by sinking wells into the landfill site. The gas is then drawn into the well head and flows into a network of gas collection pipes which transports the gas to a facility which cleans it to prepare it for use in the generation of electricity.

The wells are monitored by real-time computer-aided reporting to track the volume and composition of the gas collected. This is important as the landfill may have a variety of gasses emanating from it and also contain significant quantities of water vapour. As such, detailed understanding of the composition of the collected gas is required in order to clean it sufficiently.

The gas is burnt in a combustion engine to drive a generator to produce electricity which can be stepped up to a higher voltage and fed into the transmission grid. Landfill gas projects have a similar capacity factor to biogas plants.




## HYDRO

Hydropower plants harness the energy of flowing or falling water to generate electricity. The water is directed towards a turbine which is forced to turn by the pressure applied by the water. This converts the kinetic energy of the water into mechanical energy. The turbine drives a generator which converts the mechanical energy from the turbine into electrical energy. Hydropower plants have a capacity factor of 30% to 50%, but this is dependent on the flow of the water. In times of flood, there may be danger in operating the plant as the mechanical apparatus could be damaged by excessive force of the water. In times of drought, there may not be enough water flowing to operate the plant efficiently.

There are three major hydropower arrangements. They include diversion or run-of river plants, impoundment plants (dams) and pumped storage plants. Diversion plants divert part of the flow of a river through a turbine apparatus. Impoundment plants utilise the weight of dammed water to funnel water through a turbine, and pumped storage plants use two dams at different altitudes to create a flow of water through a turbine from the upper dam to the lower, and then refilling the upper dam by pumping the water up into it.

In the REIPPPP, the hydro plants that have been built are all small-scale diversion plants as the focus for the programme was on small-scale plants of up to 10MW in size. ■

Socioeconomic Development

# THE TRUE BENEFITS

*Kids at the Siyanakekela Disability Special Day Care Centre in Adelaide, backed by Cookhouse Wind Farm. Photo: Stuart Theobald*

One of the unusual features of the IPP procurement programme is that a significant amount of money is being pumped into communities in the areas where projects operate. Around R19.3bn has been allocated for spending on communities by the projects over their 20-year life spans. In addition, R29.2bn of free cash flow is earmarked to flow into community trusts in terms of their ownership interests in projects. Considering that most projects are in some of the poorest areas in the country, the IPP programme has the potential to radically change the fortunes of some communities.

Bidders promised to allocate between 1.5% and 3% of their top line revenue to community development, with the average allocation across all projects now at 2.2%. In addition, bidders had to ensure that community trusts owned at least 2.5% of the equity in each project. Most allocated far more to community trusts as part of the requirement that each project be owned at least 40% by South Africans, so in fact community trusts now own 11% of the projects on average.

For the producers themselves, the requirement to include a socioeconomic development plan was unusual. Normally energy tendering processes worldwide are all about price. And the requirement effectively meant that an additional tax was imposed on the projects, but one that was up to managers how to spend. "Most taxes are collected and go through Treasury and there's a political process on what this money should go through, where people can ask what it should be spent on, and whether it was spent effectively," says one of the project developers who didn't want his name published. "Essentially it puts managers of private companies into the normal role of government deciding on an allocation decision of a public tax." It is an uncomfortable position for some operators.

Other producers, however, see it more positively. "I just think the socioeconomic thing is inspired," says Paschal Phelan, head of Solar Capital. "They are forcing us guys to take responsibility in areas that the government just can't reach. They can pour all the money they like in Pretoria down that funnel, it will just never get there. Whereas we are forced to be there."

Solar Capital has its operations in De Aar in the Northern Cape, a town that had the highest foetal alcohol syndrome rate in the world with one in 10 children suffering from it, amid unemployment levels of 80%. So Solar Capital has focused on education, computer skills and early childhood support. It is backing the "Healthy Mother, Healthy Baby" programme which works with pregnant mothers to promote good prenatal care. It has put 20 hotspots into rural schools that anyone in the communities can access. It has also created a community centre, which has a computer lab which conducts free skills classes. It has also backed several start-up businesses with a programme designed by University of Free State to develop business skills. It then backed eight companies by funding their assets. "We wanted to do more than a check box approach," says Janice Finlay, head of economic development at Solar Capital. "We went out to understand what the community needed."

The Cookhouse area is going to have five large wind farms operating in it. Knowledge Pele, a consultancy that advises producers on their socioeconomic development plans, has estimated that about R20bn of free cash flow will go into that community alone over the next 20 years.

The Cookhouse Wind Farm, the first to operate in the area, undertook a major research project last year to determine an optimal approach to its community development. "Education is one of the issues in this community. That is a key priority area," says Sizile Mabaso, head of economic development at African Infrastructure Investment Managers, which oversees the Cookhouse Wind Farm. "We are using an 80/20 guiding principle in which we contribute 80% of our budget to long-term projects while 20%, because of the communities we work in, goes to smaller welfare projects."

The programme includes an intervention to support early childhood development (ECD) in the area, providing training for staff and ways to get parents more involved. "We look at all the issues facing ECD. We look at management and governance structures, parental involvement; because if you educate parents about the significance of early childhood development they will start appreciating what the centres provide and start participating more, and even contribute to their upkeep. It is important that what we do is sustainable in the long run."

The wind farm has also supported a centre for children with special needs in Adelaide. The centre had operated from a small building provided to it by a local church without electricity or cooking facilities. Cookhouse Wind Farm acquired a new building and adapted it for the children. It now has a kitchen and a student physiotherapist visits to work with the children.

The Bokpoort concentrated solar plant in the Northern Cape has supported primary schools by providing bicycles to children to help traverse the long distances to get to school. It has run a large training and apprenticeship programme to develop welders from the community, some of whom have then been employed on the plant. It has also worked with the local municipality to provide solar panels for homes in poor communities. The solar panels came with radios and TVs and they have dislodged paraffin as the main energy source, which had been responsible for many injuries and deaths in the community.

"Even prior to site establishment we had lots of engagement with the community," says Nandu Bhula, deputy managing director of Acwa Power which developed Bokpoort. "The first day we got there we sat with the community and discussed what they wanted. We signed a memorandum of understanding with the community members, with the councillors, saying these are the projects we want to undertake. So it was very well structured in getting all the locals involved."

Expectations in communities have been very high from the projects in their areas, particularly in terms of jobs. The projects, however, are not labour intensive once completed, so there are relatively few jobs in the long run. The whole programme has, according to estimates by the IPP Office, generated almost 25,000 "job years" so far in construction and almost 2,000 in operations. In addition, expectations about cash flows from community trusts have been high. Most have debt commitments that have to be met in the early years before cash flows through to shareholders, including trusts. But in the long run, the impact of the IPP programme on some of the poorest communities in the country is going to be dramatic. ■

*Bokpoort concentrated solar plant installed solar panels in the local community to lessen the reliance on paraffin. Photo: Christy Strever*

Funding

# R200bn OF NEW INVESTMENT

*Banks and equity funders put up an unprecedented amount of investment capital to make the IPP procurement programme work. Here we look at how it was done.*

***Stuart Theobald and Colin Anthony***

## BANKS

### *Uncertainty turns to enthusiasm as banks digest the risks*

*Theuns Ehlers, Absa's head of resource and project finance*

Much financial innovation went into developing the funding strategy for the IPP programme. Various funding strategies have been used, ranging from funding by large state-owned offshore utility companies through to complex structured finance involving several banks and shareholders.

It is remarkable that such a new programme was able to convince normally risk-averse financiers to contribute such large amounts of funding. When developers put bids in at the bid windows, they had to include full funding plans and banks and other funders had to commit to following through. "We had a zero negotiation policy," says Karén Breytenbach. "So we had discussed with the banks and lawyers beforehand so they understood exactly what was required from them."

That approach was developed having studied previous renewables programmes in Spain, Brazil and Germany, where the securing of the funding had become a problem after bids had been won. Theuns Ehlers, Absa's head of resource and project finance, says the process led to something the banks could rely on. "Before the programme got to the market, the IPP Office did very well in consulting widely with the banks and the IPP private sector players. We had various workshops where we discussed and debated the issues. By the time they came out we were actually quite happy that this set of documents was bankable."

Mike Peo, head of infrastructure, energy and telecoms at Nedbank Corporate & Investment Banking, says that at the time it became apparent that government needed to engage the banking sector to ensure the framework was bankable. "From day one, even though we were all dealing with brand new technologies – nobody had built anything like this in SA before –the banks were happy that the policy framework and regulatory framework were right.

"It entailed [international] developers with large-scale experience combining with South African developers. So all the banks had a good appetite for this," Peo says.

Hugh Hawarden, RMB's power and renewables contractor, says, "What did make us a bit nervous in the beginning was not knowing how rigid the request for proposals was. There was always the fear that they would be punitive if you didn't dot the i's and cross the t's. But they were fairly lenient and keen to show that the programme worked, that deals could close. So there was a bit of leeway. In some instances the developers were a bit fortunate to be allowed changes but it did show government's willingness to make the programme a success."

Investec too was full of confidence entering SA's yet-to-be developed IPP market. It started looking at renewables in 2008, before the programme had begun. "We got involved in development and secured sites for wind farms before the programme took off," says Michael Meeser, Investec's head of project finance. "We acquired options on land, then formed an energy company, Moyeng Energy, with [French utility company] Engie and Kagiso Tiso Holdings as our co-development partners. So from the outset we looked to play as many roles as possible to maximise our involvement. It's been a great decision from the bank's perspective."

He says there was one element of uncertainty, however: "The issues facing the South African market were new to it, particularly how the regulator, the environmental regulators, Eskom and other roleplayers would behave – that had to be sorted out. So the trepidation was more around whether the regulatory authorities were going to understand how to do these things. Which they have: 92 deals have been done now with all the water and construction permits, licences, environmental approvals and so on, all signed, all on time."

Meeser salutes them as pioneers in building the framework for the industry. "They developed it as it went on. Every aspect of it – technical, financial, regulators, environmental regulators – developed this skill set in the country. Everyone involved in this has been upskilled. This industry didn't exist a few years ago and neither did these skills. It's not only in the construction of the plants, but all the ancillary developments that go into producing RE.

"I think the procurement process has been fantastic. Everyone understands the rules in terms of the bidding; there is no ambiguity, which I think is very impressive," Meeser says.

In round one, part of what made the funding work was the relatively high prices. Given that it was the first time anything like it was being done, the relatively large return figures gave the banks comfort that the projects were fairly low risk.

Hawarden says the department got technical advisers in to guide them as to what tariff rates were advisable but it was based on outdated information. "So the early movers made excellent returns in round one. But I think that it was critical in getting programme up and running. Even though government thought it had overpaid on the tariff, it generated lots of interest. So it could

have been perceived as a mistake, but one worth making: it attracted lots of interest in terms of the return on investment to be made. Once the developers were here, they were here to stay."

Hawarden says one RMB client that was unsuccessful in round one came in very low on price in round two, "and that sparked a big race to the bottom. By round three everyone was cut throat in pricing." In three rounds, he says, government had achieved tariffs as low as could be found anywhere in the world.

And to top it all off, there was not a whiff of corruption. "From a banking perspective, we're very happy with how squeaky clean it is," Hawarden says. "That was the biggest risk for banks – the risk of corruption – and government has been good on that. What's also been remarkable and laudable is until now there's been very little government interference. There have been some delays but for the most part they've been very accommodating. The DoE handed it to the IPP office, and said do it." And they did.

Nedbank's Peo says the procurement methodology, with the principles of PPP, resulted in virtually every single project, 92 of them, being on time and in budget. So far no contracts have been cancelled or terminated because of any corrupt practices. That in itself is part of the miracle story of this big-scale procurement. No project in the SA market was contested.

"It has been an incredible process." ■

*Clive Elliott, chief financial officer of developers Africa Infrastructure Investment Managers.*

## SHAREHOLDERS

### *Figuring out the risks and then investing in them*

While the banks were assured, shareholders also needed to make sure that their risks were well managed. To do that, developers had to build financial models that accurately captured the risks and cash flows for a project's lifetime. That was crucial to be able to arrive at bidding prices.

Shareholders range from project developers such as giant foreign utility companies through to small community trusts from the areas of the operations.

Many private equity funds and development financiers also contributed equity to the projects. The bidding requirements stipulated that at least 40% (30% in round one) of the equity in each project had to be owned by South African entities which at least met level five black empowerment status.

As it turned out, on average 47% of the equity across all projects that have reached financial close is South African-owned with the rest held by foreign investors. Local communities had to hold at least 2.5% of the equity, but that has been far exceeded with on average 11% of the equity held by community trusts.

One of the developers, Africa Infrastructure Investment Managers (AIIM), which started out as a joint venture between Old Mutual and Australia's Macquarie but is now fully owned by Old Mutual, developed the Cookhouse and Hopefield wind farms. Chief financial officer Clive Elliott says that to develop their models they monitored wind levels around the country. "There was a view that certain areas of the country would be ideal," says Elliott, "however you needed to put up wind masts because the ground wind wasn't necessarily what you would get at 80m to 100m above ground."

The development team monitored wind levels at identified sites for 2.5 years, having begun when the possibility of IPPs was first raised in 2008. "That information was plugged into our financial models to make them relatively robust," he says. The data covered all seasons so forecasts could be made of likely generation capacity over the course of a year.

The financial models were critical. A spreadsheet error could be a disaster for shareholders if expected generating capacity wasn't realised. Projects are paid at a rate per kilowatt hour actually produced. A key feature of the programme is that National Treasury guarantees the revenue, so it would stand if, for any reason, Eskom did not pay. That gave funders comfort about taking on 20-year credit risk, but the risk of the weather or any failure to produce the expected amount of electricity was theirs.

In the case of the Cookhouse Wind Farm, the funding was split into 70% senior debt, 10% mezzanine debt and 20% equity. The debt was provided by Nedbank, Standard Bank and Futuregrowth, part of the Old Mutual group, and consisted of a mixture of inflation-linked rate and Jibar-linked rate (the Johannesburg interbank acceptance rate).

Round one debt was expensive and overall internal rates of return for the first round of projects range from 20% to 30%, ignoring the tens of millions of development costs that went into the projects. By the third and fourth rounds, the internal rates of return fell to 16% and then around 13%.

"The first round was a typical high-risk, high-reward scenario and that dissipated quickly in the subsequent rounds," says Elliott. Solar technology was seen as lower risk because sun variability tends to be less than wind variability, allowing for more certainty in the financial models.

The shareholding in the Cookhouse project was split between various equity funds, Old Mutual, and the community investment trust which holds 25%. Apollo Investment Partnership II held 39%, Africa Infrastructure Investment Fund 2 Partnership 6.9%, Africa Infrastructure Investment Fund 2 (Mauritius) 7.1%, Old Mutual SA 14.5%, Cookhouse Community Trust 25%, and AFPOC Ltd 7.5%.

Several projects are now looking to refinance the debt elements in the projects, now that there has been several years of plant performance. Risk appetites have increased so banks are willing to reduce their rates. Because refinancing amounts to a change in the project documents, the IPP Office has to give its permission.

Some developers think it will extract concessions in order to do so, such as rebates on the guarantees Treasury issued or even a drop in prices charged for the electricity.

Many state-owned funders also heavily backed the programme, including the Development Bank of Southern Africa, which was a key partner in establishing the programme, and the Industrial Development Corporation and the state-owned fund manager, the Public Investment Corporation. All of these have seen good returns from the programme. The PIC recently provided figures in parliament that show it has earned returns on equity of between 0% and 129% from the projects in its portfolio of renewable energy equity investments. ■

The Future

# DELAYS BUT LOGIC HOLDS

As this publication was going to press, uncertainty was growing over the future of the REIPPP programme. When energy minister Tina Joemat-Pettersson announced the results of the fourth bidding window in April 2015, she said a fifth bidding window would be announced in the second quarter of 2016, but it has not yet happened. Also, the results of the "expedited" bidding window held in November 2015 have not yet been announced.

Producers are starting to wonder if the programme is running aground. That fear was assuaged somewhat by the announcement earlier in October of the first two new coal projects selected using the IPP programme, indicating that there is some momentum. The concern about renewables remains.

Eskom, which is required to sign the long-term power-purchase agreements with winning bidders, announced in July that it would not sign any further agreements beyond those for the expedited round. It has increasingly expressed its dissatisfaction with the IPP programme.

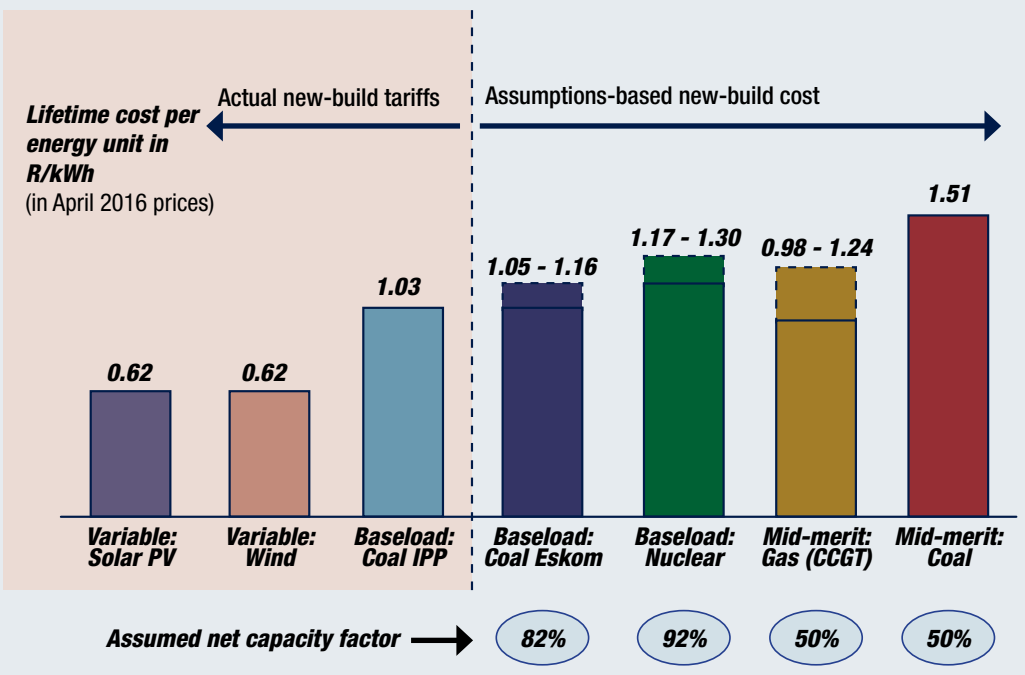
As it stands, Joemat-Pettersson has made determinations that the IPP Office should procure 14.7GW of energy from renewable producers and only 6.4GW have been procured from rounds 1-4. On the surface, that implies procurement is not even half way through. In addition, 11.4GW of non-renewable generation, including coal and gas, have been allocated to IPPs.

"There is confusion at our side as to where all this is going to go," says Paschal Phelan, head of project developer Solar Capital. "That is forcing us overseas. Which is fine – we're ready for it."

Joemat-Pettersson has publicly come out in full support of the IPP programme, but she does not have direct control over Eskom, which reports to the department of public enterprises.

At the heart of the matter appears to be the proposed procurement of new nuclear generation. This has been lobbied for by Eskom and certain quarters of the government. The difficulty is that it just does not seem to make financial sense. A study released in October by the Centre for Scientific and Industrial Research estimates that the best-priced nuclear new builds will have a lifetime energy cost of R1.17-R1.30/kWh. That compares with 62c/kWh for the most recent solar photovoltaic (PV) and wind IPP projects, and R1.03/kWh for the two recently announced IPP coal projects. Chances are those prices will fall even more in a fifth round. A recent procurement process run by Abu Dhabi resulted in solar PV priced at the equivalent of 34c/kWh.

**Latest IPP prices are cheaper than any other new build energy alternative**




Source: Council for Scientific and Industrial Research

The problem for the nuclear argument is that the cost of renewable energy has plummeted. Solar PV in the first bid window was priced at R3.65/kWh, when an argument for nuclear may have made more sense. The price decline reflects not only the dramatic reduction in the cost of PV modules and wind turbines on international markets, but also lower costs of finance and efficiencies for developers thanks to the certainty and experience created by the IPP rounds conducted so far.

"It is clear what Eskom is doing," says Anton Eberhard, who heads the management programme on infrastructure reform at the University of Cape Town Graduate School of Business, "It's what an incumbent dominant utility always does – it doesn't like the competition, it doesn't have a competitive advantage in renewables, and it wants to protect it's control over coal and nuclear power."

"The South African government needs to send a clear signal to the market so that there is investment certainty. These statements by Eskom are damaging for foreign direct investment," says Eberhard.

One of the problems holding up reconciling the future of the industry is the lack of an updated integrated resource plan (IRP) from the department of energy. The IRP is a model for the future of energy supply based on the costs and benefits of different technology and demand forecasts for the country. It is meant to be updated every two years but the last to be released was in 2010. A plan in 2013 was never made public and another apparently undertaken in the past year has not been either. Many think the problem is that the model ends up showing that it makes no sense to build nuclear and is therefore being suppressed out of political concerns.

"There have been two more [runs of the model] in the last few months that conclude that you don't need nuclear, it does not make sense and what we should be focusing on is renewables and gas, and maybe some cross-border hydro," one former energy policy advisor told us on an off-the-record basis in September. "And so that's not convenient for the powers that be that want nuclear, hence we're not getting a revision of the IRP."

The role of Eskom is often blamed by industry members for the confusion. "Eskom is a generator, distributor and transmitter. It is player and referee," says Obakeng Moloabi, head of developer Pele Green Energy. "From a generation perspective you need to have multiple generators. The IPP programme is that and it has demonstrated that when you have multiple people competing, the price advantage is going to go to the buyer." The difficulty is that because Eskom is also the distributor and often the transmitter to end consumers, it has an incentive to buy from its own generating fleet.

Many in the industry support the plans contained in the initial 1998 white paper for the future of the industry which envisage separating generation and distribution. In 2015 the Independent System and Market Operator (Ismo) Bill was proposed by the department of energy, envisaging a new state-owned entity that would be responsible for all energy procurement and then on-selling it wholesale. It would also become responsible for the IRP. However, the Ismo Bill was blocked by cabinet and is still being redrafted.

The dramatic increase in cost to consumers of electricity, combined with the slow economic growth of recent years, has certainly affected consumption. "Energy demand now in 2016 is less than it was in 2007. It's unparalleled in SA history," says Mark Pickering, managing director of Globeleq South African Management Services. "In the 100-year plus history of electricity consumption there have maybe been one or two years when demand fell from one year to the next."

That falling demand reflects the impact of higher prices and may be constraining industrial development. An expansion of the IPP programme may make it possible for low-cost electricity to become available once again, supporting reindustrialisation and job creation. That too is a powerful political objective.

"It seems nonsensical to not use our natural resources in conjunction with other forms of electricity," says Clive Elliott, CFO of a portfolio of RE companies managed by Africa Infrastructure Investment Managers. "I think it will happen but there will be a delay." ■

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