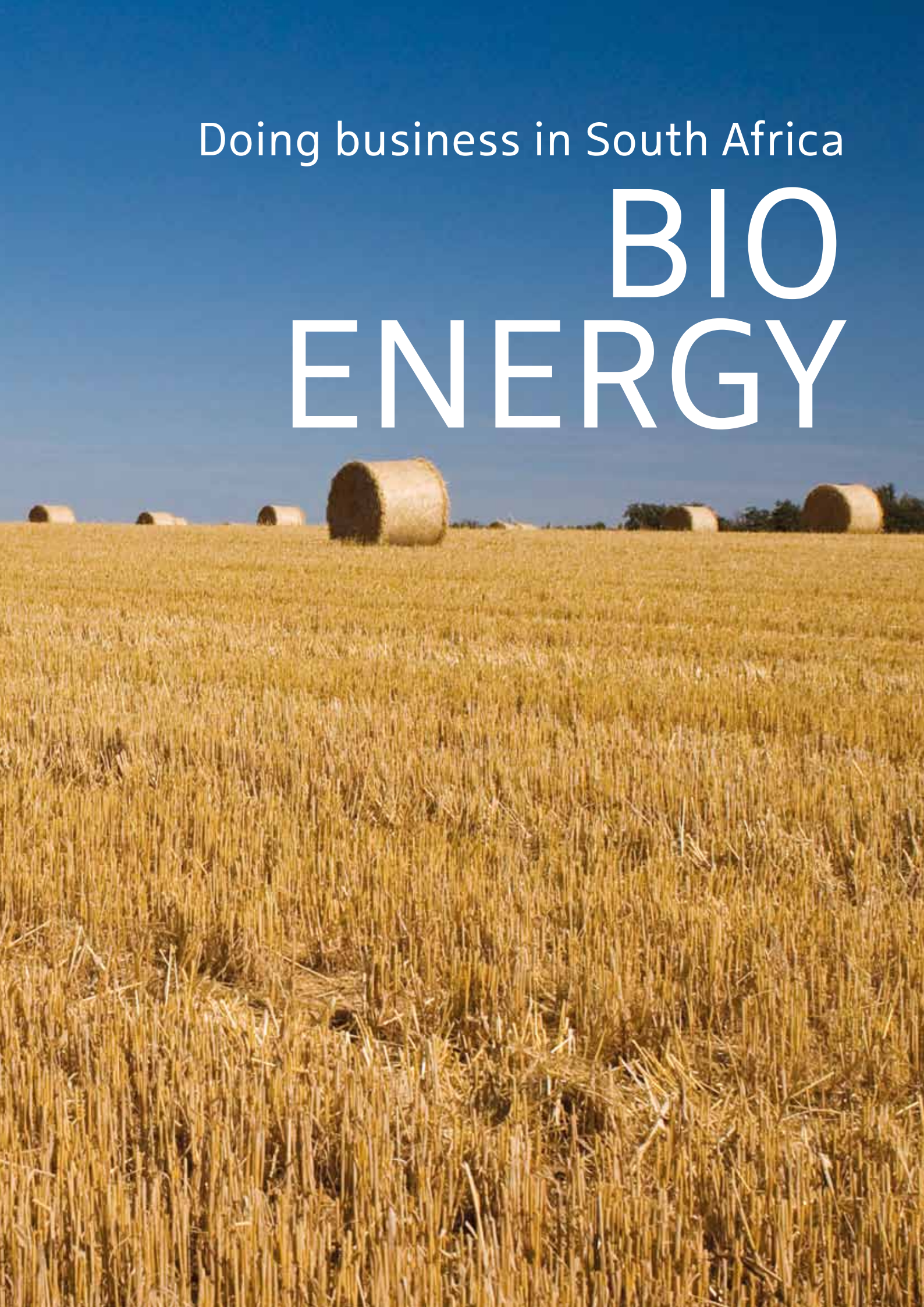
Doing business in South Africa

BIO ENERGY



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FOREWORD

This market entry study provides an overview of the South African bioenergy energy market. The study is one of four aimed at informing the entrepreneurs in the Netherlands about the South African renewable energy market with a special focus on Green Buildings, Waste-to-Energy, Bioenergy and Wind energy.

The South African demand for energy is growing and renewable energy is part and parcel of government policy. This offers interesting market opportunities for the Netherlands. The Embassy of the Kingdom of the Netherlands welcomes this development and sees potential for bilateral cooperation to strengthen the renewable energy sector in South Africa with active participation of the Dutch private sector. The Dutch renewable energy and energy efficiency industry has significant expertise in several fields of clean energy, with a high degree of knowledge, reputable research institutes and innovative industry players. The Embassy believes that cooperation between South Africa and the Netherlands could benefit both countries, as it will allow for technology and knowledge transfer and exploring new market segments.

The Embassy in Pretoria and the Consulate General in Cape Town – in cooperation with Agency NL the implementing agency of the ministry of Economic Affairs- offer support to Dutch companies that are already active or want to become active in South Africa. For more information about doing business in South Africa, our services and financial support please visit: zuidafrika.nlambassade.org or www.agentschapnl.nl.

We hope this study will assist you in exploring South Africa or expand your activities in this interesting and beautiful country. If based on this information you would like to further discuss then please contact us through pre-ea@minbuza.nl

June, 2013
André Haspels
AMBASSADOR
of the Kingdom of
the Netherlands
to South Africa.

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ACRONYMS

BRICS	Brazil, Russia, India, China and South Africa
CCS	Carbon Capture and Storage
CDM	Clean Development Mechanisms
CER	Certified Emission Reduction
CHP	Combined Heat and Power
CSP	Concentrated Solar Power
DRD&LR	Department of Rural Development & Land Reform
DoE	Department of Energy
DTI	Department of Trade and Industry
FMO	Netherlands Development Finance Company
GEF	Global Environment Facility
GCF	Green Climate Fund
GHG	Greenhouse gas
IRP	Integrated Resource Plan
IPP	Independent Power Producer
NAMA	Nationally Appropriate Mitigation Action
NERSA	National Energy Regulator of South Africa
PPA	Power Purchase Agreement
QSE	Qualifying Small Enterprise
RECP	Renewable Energy Cooperation Programme
REIPPPP	Renewable Energy Independent Power Producer Procurement Programme
SA	South Africa
SABA	Southern Africa Bioenergy Association
SADC	Southern African Democratic Community (14 countries)
SALGA	South African Local Government Association
SANEDI	South African National Energy Development Institute
SAPP	Southern African Power Pool
WRC	Water Research Commission

EXECUTIVE **SUMMARY**

NL Agency

RENEWABLE ENERGY AND BIOENERGY IN SOUTH AFRICA

In South Africa, the sectors of renewable energy in general, and bio-energy in particular are still in their infancy, but developing fast. South Africa now has an effective and efficient renewable energy support programme, a tendering scheme known as the REIPPPP (Renewable Energy Independent Power Producer Procurement Programme), which has been very successful in attracting investment in wind and solar energy, but much less so in bio-energy. The modest combined target of 25MW electricity from solid biomass and biogas has not yet been tendered for, the main reasons for this being a combination of (too) large sunk costs of presenting a bid under the programme (for most average size potential projects), long administrative procedures in obtaining all necessary permits, lack of seed funding for small(er) scale projects and missing adapted standards for bioenergy equipment and applications.

Despite such bottlenecks, the private sector is displaying signs of cautious optimism and is trying to capitalise on a number of positive recent developments, such as the emergence of dedicated renewable energy financing options (some even specific to some forms of bioenergy), new requirements in waste management and an increasing number of end users looking for a direct supply of "green" energy. In addition, fear of power shortages from the national grid are driving many larger businesses into considering generating their own power supply, and many of such businesses are in the agriculture and forestry sectors and have at their disposal significant streams of biomass feedstock. Finally, some reservations notwithstanding, the Government is supporting a number of initiatives investigating the role of bioenergy in rural development and its potential for job creation.

MEANING IT COVERS THOSE BIOENERGY TECHNOLOGIES WHICH:

- **South Africa might have an interest in developing, and**
- **The Netherlands has a competitive advantage in technological development.**

BIOENERGY OPPORTUNITIES FOR DUTCH TECHNOLOGY PROVIDERS

Bioenergy is a very complex resource, with multiple possible feedstocks, conversion routes and final applications. This study prioritizes those fields that are of most interest for a possible Dutch-South African cooperation.

As this study has endeavored to be forward looking, it also includes technologies that are very close to commercialization in the Netherlands, on the assumption that South Africa could become a potentially interesting export market for them in the near future. The main opportunities and risks for the selected bioenergy sub-sectors are summarized in the table below.

APPLICATION	IN SOUTH AFRICA		DUTCH TECHNOLOGY PROVIDERS	
	FEEDSTOCK	MAJOR PARTNERS	OPPORTUNITIES	RISKS
Biogas	Municipal sewage Industrial sewage Waste and process water Manure Plant waste Indigenous grasses Municipal solid waste	Animal farms SALGA Paper & pulp industry Food industry Dairy industry Abattoirs Agri SA Local biogas developers	• Pre-treatment of different types of waste. • Plant optimisation for different co-digestate combinations. • Recovering nutrients from digestate. • Realisation of complete farm level biogas installations.	As local manufacturing is at lower cost, the Dutch technology should be superior to be competitive.
Fuel Ethanol	Grain sorghum (now and mid-term) Agricultural and forestry residues (future)	Mabele Fuels Sugar industry Coega Industrial Development zone	• Fermentation reactor technology. • Energy efficient separation technology. • Enzymes for bioethanol production from lignocellulosic biomass.	No national blending policy for E-fuels (yet). Food versus fuel dilemma.
Biodiesel	Waste cooking oil (now), soybean and other seed crops (future).	Agri SA Coega Industrial Development zone Farming coops	• Lack of local expertise in industrial scale production of biodiesel from vegetable oil: opportunity to set industry standard.	No national blending standard for B-fuels (yet); Food versus fuel dilemma.
Torrefaction	Agricultural and forestry residues.	Eskom IPPs Sasol Sugar industry	• Pilot tests at 100 kg/h and plant design. • 50-100 kt/a torrefaction plants. • Pre-treatment for co-firing and for co-gasification. • Charcoal production.	International competition of technology providers Biomass availability on 100-200 kt/a scale.
Combustion	Agricultural and forestry residues.	Paper and pulp industry Sugar industry Eskom	• Determine fuel properties of new types of biomass for the Phyllis data. • Optimize the co-firing conditions for biomass coal mixtures. • Innovate biomass high pressure boilers to increase efficiency.	Expertise on commercial biomass combustion technology is limited in NL.
Gasification	Agricultural and forestry residues.	Eskom IPPs Sugar industry Agri SA	• Pilot tests and plant design. • 10-50 kt/a gasification equipment for off-grid electricity and process heat. • Gas purification units.	International competition (globally).
Pyrolysis	Agricultural and forestry residues.	Eskom IPPs Crude oil refineries Paper industry	• Pilot tests at 50 kg/h and plant design. • 10-50 kt/a pyrolysis plants for off-grid electricity and process heat production. • Black liquor pyrolysis.	International competition (from the USA and Finland).

SWOT ANALYSIS OF THE BIOENERGY SECTOR IN SOUTH AFRICA

The developing renewable energy market in South Africa is subject to a number of strengths, weaknesses, threats and opportunities that go across the board for renewable energy technologies. There are however also a number which are more specific to the bioenergy sector; these are summarised in the diagram.

The research conducted for this market entry study concludes that the bioenergy sector in South Africa is in its early stages of development, where a lot of testing and learning still needs to take place, which means that new developments take a lot of time. But positive momentum for several bioenergy technologies definitively exists, especially anaerobic digestion, torrefaction, gasification and biomass co-firing and the lead times for certain processes are already shortening based on the early experiences of sector pioneers. The underdeveloped character of the sector also means there is no technological lock-in, leaving room for several technology options, although local adaptations will often be needed. However, this also offers opportunities for transfer of technical skills and local capacity building. The socio-economic and business landscape of South Africa favours, indeed often demands, long-term presence and strong relationships with local stakeholders, which means South Africa should in most cases be seen as a long-term investment opportunity, either via local presence or a well-established local partner.

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Additional information compiled for this study includes a description of current activities and/or ambitions in the field of bioenergy of several of the interviewed stakeholders, who are also industry leaders, detailed socio-economic criteria against which biomass and biogas projects are assessed in the REIPPPP and an overview of companies active in the sector. All of these are available from the Embassy in Pretoria upon request.

INTERNAL

STRENGTHS	WEAKNESSES
• Significant waste biomass supply streams in some industries. • Significant job potential, especially in primary sector (agriculture and forestry, important for SA Government). • Cost reduction of bio-waste disposal.	• Financing vacuum for small projects & insufficient low-cost funding. • Biomass vs coal price: biomass still too expensive to represent a viable alternative to coal at 2-3 times the cost. • No formal, managed approach to optimal resource utilisation and allocation.

EXTERNAL

OPPORTUNITIES	THREATS

• Some large players considering significant investment into biomass (Eskom, Sasol, sugar industry).
• Some dedicated funding is available.
• Government is assessing the potential for bioenergy more seriously (recently commissioned a Bioenergy Atlas for SA).
• Substantial demand for co-generation of electricity and hot water.
• Importing biomass form neighbouring SADC countries that do not have water scarcity.
• Improved waste management requirements.
	• Government reservations on using food crops for energy purposes, resulting in
	  • insufficient Government support
	  • weak Government bioenergy strategy.
	• Sectoral in-fighting limiting further developments.
	• Inefficient use of some biomass streams.
	• Water scarcity limits substantial increase in biomass production via agriculture and forestry in certain areas.

1 INTRODUCTION TO THE SOUTH AFRICAN ENERGY SECTOR

1.1 Current energy supply in South Africa

By the beginning of 2012, there were only 26MW of renewables installed in South Africa, of which two biomass and waste and two wind energy projects[1]. Despite its abundant renewable resources, over 90% of electricity in South Africa (SA) is provided by coal. The current energy mix, together with SA's very energy intensive industries and energy-wasting consumer habits, developed due to cheap electricity in the past, cause SA to be one of the world's top polluters. If land-use emissions are excluded, it ranks as the 20th highest emitter of CO^2 in the world and 45th on per capita emissions, even with some 20% of the population still lacking access to the electricity grid.

South Africa needs to meet 29,000MW of new power demand between now and 2030. In addition to this, the current energy infrastructure is increasingly inadequate to meet the country's growing energy needs. The predominantly coal-fired power plants belonging to Eskom, the nation's para-statal utility company, are mostly ageing installations burning low-grade coal, of which 10,900MW will need to also be retired by 2030. The country's power capacity reserve margin has been declining steadily from a comfortable 30% in the nineties to only 1% in March of 2013, due to simultaneous unplanned outages at several Eskom facilities, (although by April it was back above 10%[2]). Such fluctuations in the reserve margin show that the grid is often under considerable strain and in 2008, after years of significant power production surpluses, which were exported all over the region, South Africa experienced a major energy crisis, which resulted in blackouts and cutbacks in industrial production. Eskom has since embarked on a significant demand-side management programme, as well as agreed several electricity buy-back contracts with its major industrial off-takers, which allowed it to supply the municipalities and its residential users. However, when the current buy-back contracts laps in June 2013, Eskom might not be able to extend them, which will put further strain on the utility's ability to supply sufficient electricity to the South African economy until new generating capacity comes on line[3].

To help bridge the electricity gap in the short term, South Africa is unlikely to be able to increase electricity imports from its neighboring countries, organized in the Southern African Power Pool (SAPP), as SAPP itself currently has a combined negative reserve margin of about -4,6%, or a shortfall of 7.709MWs of generation capacity.[4]

Combined with the need to increase access to modern energy services, the key energy challenge in South Africa is to expand and diversify its energy supply in the direction of a more accessible and sustainable energy system, without having to raise electricity prices too much, too fast. The Government is of the view that South Africa needs to reduce GHG emissions while working to ensure economic growth, increase employment, and reduce poverty and inequality.[5] The challenge for the Government is enormous, but after years of stop-and-go policies and failed programmes, there is now evidence of positive change ahead.

1.2 Policy shift to renewables and the REIPPPP

The need to expand and diversify the country's energy mix from its dependence on coal was first signalled in 2003, when the South African Government set a target of 10.000GWh[6] of energy to be produced from renewable energy sources by 2013.[7] In 2010, a more ambitious target has been set in the country's Integrated Resource Plan (IRP), which maps South Africa's energy strategy until 2030. The IRP outlines a programme aiming at 19GW of renewable energy capacity installed in the country by 2030,[8] out of the 46GW needed to meet its growing energy demand by the same date. Of this, 8.4GW should be contributed by wind; 8.4GW by solar PV and only 1GW by other renewables. Taken together, renewables are thus expected to contribute some 20% of national electricity supply.[9]

It has taken the South African Government almost 8 years to work out the main support system for its renewables target. The initially proposed Feed-in-Tariff, or REFIT scheme, was dropped in August 2011 in favor of a tender mechanism known as the Renewable Energy Independent Power Producer Procurement Programme (REIPPPP), which was originally intended to be implemented over five rounds (bidding or submission windows), between 2011 and 2013.[10] Under the tender mechanism, bidders propose a tariff which will fall under a technology-dependent cap. Experts in the sector consider these caps to be reasonable and offer support comparable to other countries.[11] A first ministerial determination mandated the REIPPPP to commission a target capacity of 3.725MW, by and large to be achieved with onshore wind and solar PV.

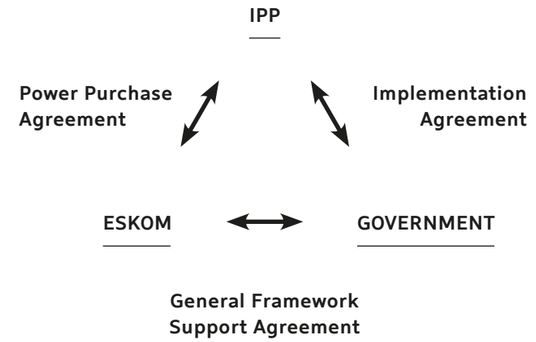
1. Bloomberg New Energy Finance, September 2011
2. https://m.research.standardbank.com/#/Research?view=1671-1F1DB337E7F14103811B37FD3B-B8E42C-1
3. http://www.fm.co.za/economy/2013/04/04/eskom-s-buy-back-blues
4. http://www.engineeringnews.co.za/print-version/sapp-to-commission-18-000-mw-of-additional-power-generation-capacity-by-2016-2013-04-09
5. National Treasury, 2010
6. This would be equivalent to about 4% of electricity generation in South Africa in 2013.
7. Department of Minerals and Energy, 2003
8. Department of Energy, 2011
9. Department of Energy, 2011
10. By now it is however clear that by the end of 2013 a maximum of three submission windows will have been implemented.
11. Bloomberg New Energy Finance, September 2011

TABLE 1: RENEWABLES TARGET CAPACITIES UNDER THE FIRST PHASE OF THE REIPPPP

TARGET CAPACITY	TECHNOLOGY
1,850MW	Onshore wind
1,4501MW	PV
200MW	Solar thermal
75MW	Small hydro (> 10MW)
25MW	Landfill gas
12.5MW	Biomass
12.5MW	Biogas
100MW	Small projects (< 5MW)

So far, two bidding windows have been successfully concluded, and the Request For Proposals (RFP) has been issued for the third window, closing on 19th August 2013. Signing of the Power Purchase Agreements (PPAs), Implementation Agreements and Direct Agreements for this submission window has been scheduled for 30 July 2014. After the third one, the Government plans to have one bid submission window per year.
The fourth bidding window would therefore be in August 2014, but this is yet to be officially announced.

FIGURE 1: CONTRACTUAL ARRANGEMENT IN THE REIPPPP



The two stage selection process requires projects to first pass the qualification stage, where they prove compliance with a number of demands, including on land, environmental consent, economic development, price, capacity, financial criteria and technical criteria. It is important to note that the technical criteria set forward in the qualification stage do not allow for anything but mature technologies to qualify (most technologies need to have a proven track record of operation of between 12 and 36 months).

If projects are found to comply with criteria related to all of the above issues, then they go through an evaluation stage, where 70% of the score is geared towards the financial aspects of the project, and the remaining 30% is derived from its expected economic/development impact (please see Figure 2 for a graphic representation of the selection process and a detailed breakdown of the weight assigned to each economic/ development component). Such a request to deliver a development dividend is typical of most public procurement in South Africa, but at 30% of the final score, its role in the REIPPPP is particularly prominent. Minimum thresholds for job creation, local content, ownership, and socio-economic development are clearly set out by the Department of Energy (DoE). In respect of management control, preferential procurement and enterprise development, bidders are free to choose which economic development elements they would like to pursue in a particular project, if not all.[13] In addition, it is important to note that bidders are also required to have at least a 40% local (South African) participation in the project company. Finally, it is worth mentioning that provinces have a right to adapt national legislation to make it stricter, however it is not known that any province has tightened requirements for REIPPPP projects to be developed within their administrative control.

The economic development criteria also serve as a kind of eligibility filter which makes bidding significantly easier for organisations that have been involved in South Africa for a number of years, since they will have a better understanding of the requirements and are likely to have already established joint ventures within the country.[14]

FIGURE 2: THE SELECTION PROCESS & EVALUATION PARAMETERS UNDER THE REIPPPP

PART A: QUALIFICATION STAGE	PART B: EVALUATION STAGE (30% final score)		PRICE (70% final score)
COMPLIANCE	ECONOMIC DEVELOPMENT	WEIGHTING	
Environmental consents	Ownership	15%	
Land	Management control	5%	
Economic development	Preferential procurement	10%	
Finance	Job creation	25%	
Technical	Local content	25%	
Price	Entreprise development	5%	
Capacity	Socio-economic development	15%	

A particular concern raised especially by finance providers, is the local content requirement. Many banks are anxious over the South African market's readiness to ensure sufficient quantity and quality of materials and maintenance for the correct long-term operation of the projects they are looking to finance.

The DoE is the main government department in charge of developing national energy legislation and programmes. The implementation of the REIPPPP also falls within its competence. The Department carries out the whole procurement process, starting with the definition of eligibility criteria, evaluation of the received proposals and finally it also enters an implementation agreement with the Independent Power Producers (IPPs) that achieved preferred bidder status (after they have secured a PPA with Eskom).

13. Department of Energy, 2011a
14. Bloomberg New Energy Finance, September 2011

TABLE 2: RENEWABLES TARGET CAPACITIES UNDER THE SECOND PHASE OF THE REIPPPP

TARGET CAPACITY	TECHNOLOGY
1,470MW	Onshore wind
1075MW	Solar PV
400MW	Solar thermal
60MW	Small hydro (> 10MW)
47,5MW	Biomass
47,5MW	Biogas
100MW	Small projects (any type of renewables < 5MW)

For the first 3.7GW in renewables procurement, most incremental costs are being covered by the South African government. However, this model is not viable for the full rollout of the 19GW renewables envisaged in the Intergrated Resource Plan (IRP), so the Government is now looking at various partnerships to help it raise the funds necessary to achieve its renewables targets. Experts estimate that achieving the IRP's goal for renewables will require an investment of $35.6 billion in renewable capacity by 2030.[15]

In fact, as the first REIPPPP is unfolding, a second ministerial determination has already been issued which extends the programme for another 3.200MW until 2020, to be distributed as described in table 2.

Similarly to other support programmes, the REIPPPP also involves significant sunk costs for developers, which might end up being prohibitive for smaller scale projects. To attract smaller projects which typically have wider socio-economic benefits, the Government has recently established a separate Small Generators programme under the REIPPPP for electricity generation projects sized between 1MW and 5MW, with simplified bidding procedures. The first invitation to bid under this programme is expected by the end of 2013.[16]

More information on the REIPPPP and the Small Projects IPPPP is available on the respective programme websites ipprenewables.co.za/ and www.ipp-smallprojects.co.za

1.3 Current state of play in the field of renewable energy in South Africa

Despite some initial issues, the Government now has both an effective and efficient support framework for renewables in the form of a competitive public procurement programme, which testifies to its commitment to supporting the development of a renewable energy sector in the country.

After the first two bidding rounds, the Government has received over 130 bids from project developers, and by July 2012, 47 projects were selected, which should deliver almost 2.5GW of renewable capacity, of which approximately 1GW of solar PV, 1.2GW of wind and 200MW of CSP. [17] Between the first and second bidding rounds, the price of electricity offered by the IPPs have come down significantly, with further reductions expected as the program unfolds.[18]

15. Ward, 2012
16. http://www.engineeringnews.co.za/article/doe-to-approach-small-power-producers-for-reipppp-before-year-end-2013-04-09?utm_source=Creamer+Media+FDE+service&utm_medium=email&utm_campaign=EngineeringNews%3A+Gautrain+2012+ridership+up+60%25%2C+placing+%27severe+strain%27+on+capacity&utm_term=http%3A%2F%2Fwww.engineeringnews.co.za%2Farticle%2Fdoe-to-approach-small-power-producers-for-reipppp-before-year-end-2013-04-09
17. http:// www.energy.gov.za/files/media/pr/2011/MediaStatement_IPP_07Dec2011.pdf
18. Part of the reason for a very sharp decline in renewable electricity prices between the first and second bidding round is likely to be in an administrative hick-up in the implementation of the programme, whereby the DoE failed to only allocate part of the total programme capacity to each bidding round, but offered the full target capacity in the first bidding window, which ended up being undersubscribed (hence no real competition took place). This was immediately corrected for the second bidding window, which brought about the sharp decline in prices.
19. Currently planned for 2015.

Preferred bidders from the first bidding window suffered significant delays in reaching financial close, which were largely related to government approvals. However, now that most of the procedures are well in place and the initial learning has been absorbed, there is confidence in the sector that further bidding rounds will be processed more in line with the planned timeline. By May 2013, many of the REIPPPP projects selected under the first bidding window are well under way with construction and the preferred bidders from the second bidding wind have reached financial close in the beginning of the same month. In total, the Government has now awarded over 2.200MW of the target 3.700MW of renewable electricity capacity, none of which is based on biomass or biogas.

After the initial hick-ups, the renewable energy sector is now developing very fast. Many European renewable energy companies are setting up shop in South Africa, from project developers to manufacturers, in view of the local content requirement. Crucially, many finance institutions are now interested in providing funding to renewable energy projects in South Africa due to a reliable government support scheme and the general consensus that several types of renewables are likely to reach grid parity in the coming 3-5 years, especially if the planned carbon tax is really introduced.[19]

This situation offers ample opportunities for private sector and public-private partnerships between foreign and local businesses and institutions. The Dutch renewable energy industry has extensive experience in supplying renewable energy and advanced technological solutions to many of the practical implementation problems likely to arise in South Africa. This puts it in a unique position to support the development of the nascent renewable energy sector in South Africa, which will benefit local private sector development as well as generate commercial perspective for Dutch parties.

1.4 Electricity prices

South Africa is a very electricity-dependent economy, hence electricity prices have a very large impact on its competitiveness. The long-lasting practice of providing electricity at prices below its full financial cost makes investing in new electricity generation problematic, for both coal and renewable generation. This problem is being addressed by a rapid increase in electricity tariffs – about 25% per year from 2010 to 2012, despite the fact that this measure encountered significant domestic resistance. Even without any pressure from the introduction of renewable

resources, the country is faced with more fast increases in electricity prices. After more-than-doubling of prices since 2005, Eskom has requested that the National Energy Regulator of South Africa (NERSA) grants it an additional 16% average annual increase of its electricity price over the coming five years. Only a very small part of this increase is due to Eskom's obligation to buy-back renewable electricity from IPPs.

The requested electricity price increases by Eskom have caused a lot of turmoil among both residential and industrial users and raised concerns on competitiveness of South African businesses, especially the heavy electricity users. In addition, several civil society initiatives have argued that the price increment requested by Eskom would allow it returns that are higher than necessary for a public entity. In the end, NERSA granted only an 8% average annual increase for the coming five year period. This will bring the price of wholesale electricity from R65.51c/Kwh in 2013/14 up to R89.13c/kWh in 2018.[20] Nevertheless, in its recent Economic Survey of South Africa, the OECD claims that the electricity prices in South Africa are still below the OECD average and need to further increase to reflect the real marginal cost of power production in the country.[21]

A final point to note is that in South Africa, most of the electricity distribution to residential end users and small businesses is done by municipalities, which buy power from Eskom at wholesale price, and add a varying (depending on municipality) margin to the retail price. Municipalities in South Africa have historically been using their electricity revenues to cross-subsidise other public services. While this model of public service financing has seen some criticism lately, especially for its inhibition of net metering, it is unlikely to change in the near future.
While this is inhibitory to the development of larger (i.e. larger than own consumption) solar home systems, it is less relevant for bioenergy installations, as those developed on a very small, household scale do not normally generate electricity (but use biogas directly for cooking or lighting), and the commercial size applications can request grid access as IPPs.

20. NERSA media statement http://www.nersa.org.za/Admin/Document/Editor/file/News%20and%20Publications/Media%20Releases%20Statements/Media%20Statement%20-%20Announcement%20of%20NERSAs%20decision%20on%20Eskoms%20Revenue%20Application%20for%20the%20MultiYear%20Price%20Determination%20period%202013-14%20to%202018%20(Final).pdf
21. Organisation for Economic Cooperation and Development, March 2013

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2 GENERAL INFORMATION ON THE BIOENERGY SECTOR IN SOUTH AFRICA

2.1 Biomass for energy use in South Africa to date

Biomass is still the predominant renewable energy resource used in South Africa (as in the rest of the continent), but this mainly applies to the inefficient, traditional use of biomass (wood or animal waste) for cooking. Although important improvements to household biomass use in the form of more efficient stoves have been championed in many parts of Africa, with Eastern Africa being one of the more successful ones, it has not really taken off in South(ern) Africa. Use of modern biomass technologies beyond the household level has so far also been very limited, but this is now changing fast. Various organisations have been active in the development of bioenergy across the value chain. World class research on a number of biomass technologies is being conducted at several of the country's universities, feedstock providers are increasingly aware of the added value of their product, project developers are expanding the size and scope of their projects, local government is increasingly aware of the socio-economic benefits of certain types of biomass energy projects and many end-users are now looking for "green" energy.

After several delays and stop-and-go signals from the Government, the market for renewables in South Africa is finally ready to start developing the country's renewable energy potential. While the main government support programme for renewables clearly favours wind and solar energy, it does lay the foundations for a wider use of renewable energy across the technologies (and resources) spectrum. And if bioenergy might not have been given sufficient support or even attention in the REIPPPP, there are other incentives for it to develop in South Africa, starting from more stringent waste management requirements, increasing prices of imported fuel, a renewed interest in uplifting local agriculture and reducing companies reliance on Eskom for power provision. Even more interestingly for companies offering bioenergy technology, is the fact that some major players in the South African energy sector are currently considering large-scale investment in bioenergy. Some of these initiatives are described in chapter 4.

At the time of writing, only the following commercial biomass energy installations were operational:

TABLE 3: OPERATIONAL COMMERCIAL SIZE BIOENERGY PROJECTS IN SOUTH AFRICA BEGINNING OF 2013

NAME	SIZE/CAPACITY	DESCRIPTION
Mondi Richards Bay Biomass Project	13.2MW	Use of biomass residues from plantations and nearby chipping facilities as fuel in a co-fired boiler, replacing coal in Mondi Business Paper pulp and linerboard production facility in Richards Bay.
WSP Energy Mossel Bay Biogas Plant	4.2MW	Waste water from PetroSA operated gas-to-liquids plant at Duinzicht is used as feedstock in the anaerobic digestion process in this biogas-to-electricity plant in Mossel Bay.
BioGreen Diesel	160 000 litres/month	The Cape Town plant produces biodiesel from waste oil collected from restaurants, hotels and other sources.

2.2 Policy framework

2.2.1 Bioenergy in the REIPPPP

As mentioned, biomass energy does not feature prominently in the REIPPPP, with only 25MW equally divided between solid biomass and biogas. This figure is rather limited compared to the country's estimated potential for bioenergy, and there is no clear explanation for the Government's shying away from it, after having it dedicated quite some attention in its 2003 White Paper on Renewable Energy.

Despite the modest targets, after the first two bidding rounds, no bids were submitted from biomass or biogas developers, leaving all the 25MW assigned to these two sources still available for development.

THERE ARE TWO MAIN REASONS FOR THIS:

- **The minimum 1MW requirement disqualifies many potential projects at single feedstock source (especially for animal and plant waste).**
- **Although the initially proposed tariff caps for electricity from biomass and biogas were ZAR 1 070/MWh and ZAR 800/MWh, respectively,[22] which is comparable to biomass-based electricity support systems in Europe and in the world, the initial sunk costs of presenting a bid under the REIPPPP were too high to make even biomass projects with capacity in the order of few MWs viable. This issue should be addressed with the small-scale IPP procurement programme, the main aim of which is to lower the cost barrier for smaller projects. In addition, the price caps have since been adjusted, and the price caps for fully-indexed prices to be proposed by bidders of biomass projects in the third bidding window are now ZAR 1400/MWh (biogas caps have remained at ZAR 800/MWh).**

The further development of solid biomass and biogas under the REIPPPP is subject to conflicting information. Due to the low interest in them so far, government is considering moving them (together with landfill gas) under the Small Projects IPPP after the third submission window.[23] At the same time, because several initiatives to use solid biomass as fuel are known to be developing (mainly in co-firing, but also as stand-alone biomass-only installations[24]), the target capacities for solid biomass issued under the first and second determinations have been grouped together and offered for development under the third bidding window. The submissions under the upcoming window will therefore most likely determine the future of bioenergy in the REIPPPP.

If submitted under the REIPPPP, each project has to comply with a number of technical criteria to pass the qualification stage. For biomass and biogas projects the criteria are as listed in table 4.

In the evaluation stage, the projects will be assessed against a number of economic development requirements, as outlined in section 2.2.[27]

22. Bloomberg New Energy Finance, September 2011.
23. Date and the outcome of this consideration will be communicated in a DoE Briefing Note to follow.
24. More information on those initiatives is presented in Section 4.
25. Source: South African Department of Energy, 2011.
26. Anywhere in the world.
27. Please contact the Embassy for the economic development scorecard specific to biomass and biogas projects.

TABLE 4: TECHNICAL CRITERIA FOR BIOMASS AND BIOGAS PROJECTS UNDER THE REIPPPP[25]

	CAPACITY	PROVEN TECHNOLOGY	ENERGY RESOURCE CERTAINTY	GENERATION FORECAST	DEVELOPER AND CONTRACTING COMPANY CAPABILITY	PROJECT SCHEDULE	GRID CONNECTION	WATER CONSUMPTION
BIOMASS	1MW – 10MW	Key plant items must have been in use for at least 12 months each in 2 different commercial projects. Technical Availability of at least 75% for 12 months.	Provide a fuel supply agreement to confirm the availability of fuel to meet the facility's demand for the first 2 years of operation.	Bidder must state the average annual forecasted energy yield [MWh/year] on an annual basis for the first 20 years of operation.	This must be proven through the provision of their experience.	A project timeline must be provided, with commercial operation date by June 2014 (for First Bid Phase) and end 2016 (for any other Bid Phase).	Ability to comply with grid codes. Time and cost for grid connection must also be provided.	Water consumption requirement must be provided.
BIOGAS	1MW – 10MW	The proposed anaerobic digestion concept must have been in use for at least 24 months in two different commercial projects.[26] Technical Availability of at least 80% for 12 months.	Provide a fuel supply agreement to confirm the availability of fuel to meet the facility's demand for the first 2 years of operation.	Bidder must state the average annual forecasted energy yield [MWh/year] on an annual basis for the first 20 years of operation.	This must be proven through the provision of their experience.	A project timeline must be provided, with commercial operation date by June 2014 (for First Bid Phase) and end 2016 (for any other Bid Phase).	Ability to comply with Grid Codes. Time and Cost for Grid Connection must also be provided.	Water consumption requirement must be provided.

NOTES: Biomass and biogas projects between 1 and 5MW can qualify under the Small Projects IPP Procurement Programme (also see end of section 2.2 for more info on Small Projects Programme).

2.2.2 Other policies & programmes relevant to the bioenergy sector

Being the complex resource that it is, biomass requires a number of other policies and guidelines to govern its development as an energy resource. Despite significant momentum among bioenergy stakeholders in South Africa following the Government's White Paper in 2003 and the subsequent research and public dialogue that aimed to provide the country with a clear and ambitious bioenergy strategy, a comprehensive document guiding the sector's development is yet to emerge.

There are however specific laws and guidelines, or lack thereof, that govern the development of specific types of bioenergy in South Africa, that need to be considered by companies interested in entering the local market – the most important are mentioned in section 4 under individual sub-sectors to which they are applicable.

The one bioenergy sub-sector the Government has prepared a specific strategy for, is that of biofuels - the Biofuels Industrial Strategy of the Republic of South Africa , issued in 2007.

The initial momentum to build a biofuel industry in South Africa pre-dates this policy document and was mainly based on the country's agricultural surpluses. There was a need to find other value added applications especially for the country's maize and sugar production excesses. However, the food crisis of 2007/08 sparked the global food versus fuel debate which prompted the South African Government to cut back on its initial biofuel ambitions. The subsequently published Biofuel Strategy set the modest goal of 2% biofuels in the country's national transport fuel consumption or 400 million litres per year to be based on local agricultural and manufacturing production. The Strategy also makes clear demand on which kind of feedstock may be used for biofuel production: for bioethanol, it is sugar cane and sugar beet and for biodiesel sunflower, canola and soya beans. Maize and jathropa are explicitly excluded as possible biofuel feedstocks based on food security concerns.

The Strategy also includes support mechanisms for biofuels, mainly in form of fuel levy exemption (50% for biodiesel and 100% for bioethanol), but lacks any concrete blending regime, which makes achieving even its modest targets unlikely.

2.2.3 Policy goals and dilemma's

Biomass as an energy source offers simultaneously many potential benefits but also threats, if not managed correctly. In the context of an emerging economy such as South Africa, with its wide economic inequality and underdeveloped and underserviced rural regions, the dual nature of this resource holds even more true and gives rise to a number of policy dilemmas. In this section we analyse the most prominent ones, but other socio-political considerations are likely to be present, especially on a more local, project level.

The main political issue is that of the food vs fuel debate. Despite South Africa mostly being a net food exporter (although there is some debate among agricultural economists over different methodologies yielding somewhat inconsistent results on this), the Government is of the view that food staples such as maize should not be used as a biofuel feedstock, and explicitly prohibits this. This concern is based on the premise that although on a national level, South Africa's agricultural output is sufficient to meet the aggregate food demand, food security is not uniformly assured across the country, with some provinces being more susceptible to food shortages than others.

Another very important issue is the availability of water in South Africa. Due to relative water scarcity, South Africa is not a country perceived as having significant potential for agricultural expansion and hence production of 1st generation biofuel feedstock. At the same time, South Africa still has some 2 million hectares (or 14%) of idle agricultural land, as well as underdeveloped agriculture in some regions, especially the former homelands, where improved agricultural practices could boost productivity of both food and industrial crops. A recent initiative sponsored by the Dutch Government is trying to tackle this: by using intercropping practices (growing maize for food and soybean for biodiesel) in the Eastern Cape, the South African National Development Agency is trying to give a cooperative of local farmers the skills and tools necessary to produce these two types of cash crops and increase local food security while also offering farmers the opportunity of earning an additional revenue stream by selling biofuel feedstock.

Finally, it has to be mentioned that job creation is very high on the agenda of the SA Government, especially in the rural areas, which has been re-stated in the recently issued National Development Plan (NDP)2030. The NDP highlights agriculture and rural development as part of SA's growth plans but also articulates clearly the need for renewables and alternative energy supplies and their link with agricultural and rural development (especially via investment in infrastructure). This means any project aiming to produce bioenergy feedstock, especially from land agriculture and forestry, needs to consider job creation and skills development as part of its strategy.

28. http://www.info.gov.za/view/DownloadFileAction?id=77830
29. Department of Minerals and Energy, 2007
30. http://www.agentschapnl.nl/sites/default/files/bijlagen/All%20projects%20sustainable%20biomass%20NPSB_0.pdf
31. http://www.info.gov.za/issues/national-development-plan/

2.3 Industrial associations

ASSOCIATIONS FOCUSING ON RENEWABLES IN GENERAL, WHICH ALSO HAVE BIOMASS WITHIN THEIR INTEREST SCOPE:

- **Southern African Alternative Energy Association (SAAEA) (www.saaea.org); also has a tenders section.**
- **The Sustainable Energy Society of Southern Africa (SESSA) (www.sessa.org.za); mainly focuses on solar energy and heat pumps, but has an interest group on bio-energy.**

The limited market activity so far is reflected in the lack of industrial associations with noteworthy track records. The Southern African Bioenergy Association (SABA) (www.saba.za.org) was established in 2004 to promote the sustainable production and use of biofuels in South Africa and has been actively involved in the policy development of the sector. Initially, it had over 60 members, covering the whole value chain, from agricultural associations, process engineering companies, fuels companies and financial institutions. After the initial drive, the National Biofuels Strategy has all but stalled activity in the biofuel sector in South Africa, and the association has been largely inactive since 2011, due to the Government's retraction of its biofuel ambitions. Nevertheless, SABA still has an active chairman and is a very good source of information on the current state of affairs on the country's biofuel market.[32]

The more recently (December 2012) established South African Biogas Industry Association (SABIA) (http://biogasassociation.co.za/) is the natural upshot of the recent developments in the biogas sector in South Africa (see section 4.4.1 for more information).

2.4 Research organizations

Several Universities in South Africa have research groups focusing on various types of biomass energy.

The Center for Renewable and Sustainable Energy Studies (CRSES) at Stellenbosch University (SUN) is the country's premier institution for postgraduate training and research into all types of renewable energies. In addition to CRSES, Stellenbosch University also holds the Senior Chair in Energy Research: Biofuels and other clean alternatives (CoER). The CoER biofuel chair has been approved for funding for the next 5 years by the National Research Foundation (NRF), and for the duration of this period will be allocated R3 mio/year for research projects and R1 million per annum for bursaries. In addition to the NRF funding, the bio-energy group at Stellenbosch has contracts with industry bringing its total annual turnover to the order of R5 to R10 million per annum. A short overview of the main centres of research activity can be found in table 5.

TABLE 5: MAIN CENTRES OF BIOENERGY RESEARCH IN SOUTH AFRICA

UNIVERSITY/ INSTITUTE	RELEVANT RESEARCH AREAS	CONTACT PERSON(S)
Stellenbosch University of Technology Center for Renewable and Sustainable Energy Studies www.crses.sun.ac.za	• Biological conversions of biomass-to-ethanol • Thermo-chemical conversion routes • Biorefinery modelling • Process optimisation modelling	**Prof Dr Emiel van Zyl whvz@sun.ac.za Dr Johann Gorgens jgorgens@sun.ac.za**
University of Cape Town African Centre for Cities africancentreforcities.net	• Biogas	**Ms Rethabile Melamu rb.melamu@uct.ac.za**
University of Pretoria Department of Chemical Engineering web.up.ac.za/default.asp?ipkCategoryID=2063	• Pyrolysis	**Prof Mike Heydenrych mike.heydenrych@up.ac.za**
University of Fort Hare Fort Hare Institute of Technology fhit.ufh.ac.za/renewable-energy-gasification.php	• Biomass gasification	**Sampson Mamphweli info@fhit.ufh.ac.za**
Council for Scientific and Industrial Research (CSIR) Biosciences[33] www.csir.co.za/biosciences	• Algal biodiesel	**Dr Daniel Visser dvisser@csir.co.za**
University of South Africa (UNISA)/ Material and Process Synthesis (MaPS)[34]	• Small- and medium-scale Fischer-Tropsch	**Diane Hildebrandt diane.hildebrandt@outlook.com David Glasser david.glasser@wits.ac.za**
North-West University/Energy Systems www.nwu.ac.za/fe/research-current	• Advanced biofuels • Co-gasification	**Sanette Marx sanette.marx@nwu.ac.za**

32. For more information about doing business in South Africa's biofuel sector contact SABA chairman Andrew.makenete66@gmail.com

33. The CSIR also supports innovation by offering accessible and affordable support for development, piloting and prototyping and business support and incubation to both established an emerging enterprises.

34. No website yet available for this newly established research centre.

2.5 Regulatory bodies and requirements and implementing agencies

Besides the DoE, already mentioned in Section 1, there are a number of other relevant organisations, both national and international, businesses wishing to engage in the bioenergy sector in South Africa should be aware of, depending on the scope of operations.

NATIONAL BODIES

The National Energy Regulator (NERSA – www.nersa.org.za) is a regulatory authority with a mandate to regulate the Electricity, Piped-Gas and Petroleum Pipeline industries in South Africa. NERSA issues licenses with terms and conditions for generation, transmission and distribution of electricity, import/export of electricity and traders in electricity. It is also in charge of economic regulation of the electricity supply industry, which effectively means it sets power tariffs and their structure (or approves or disapproves of those). Finally, it has an important role in the planning of the country's electricity infrastructure.[35]

South Africa National Energy Development Institute (SANEDI – www.sanedi.co.za) is the implementation agency for DoE policy and approval agency for renewable energy projects.

South African Bureau of Standards (SABS - www.sabs.co.za) is the national body in charge of product testing, standardization and certification of products and services sold on the South African market. It is currently working with various players (companies, industrial associations) to develop standards in the bioenergy field.

REGULATORY REQUIREMENTS

Regulatory requirements in South Africa are elaborate and cumbersome. Experience of project developers so far shows that gathering all the necessary licenses and permits for a stand-alone new installation can take up to 5 years. An Environmental Impact Assessment (EIA) alone can take around 18 months, even for a small project. At the same time, these timelines are mainly based on pioneering projects in the sector, and there is a general consensus in the industry that regulatory procedures in the future should become shorter, as relevant government departments move along their learning curve on bioenergy.

INTERNATIONAL BODIES AND REQUIREMENTS FOR BIOMASS EXPORTS

In case raw or treated biomass (i.e. wood pellets) is harvested and/or processed in South Africa and exported, it will be subject to international sustainability requirements, in addition to local regulations. If biomass is exported to Europe, mandatory sustainability certification under one of the sustainability schemes recognized by the EU (ISCC, NTA8080 and RSB or other) will apply. However, in case a project is developed under the Gold Standard,[36] the FMO Sustainable Energy Strategy and the African Carbon Asset Development (ACAD) facility, it does not need additional sustainability certification, as each of these climate finance instruments requires that the climate change mitigation project in question complies with one or more of sustainability certification schemes[37] to be able to obtain funding from them. At the same time, it should be noted that in other cases, even though similar requirements need to be fulfilled under certain climate finance instruments and sustainability schemes, there is only very limited possibility to actually substitute reporting and monitoring requirements under one track with reporting and monitoring under the other track, as each track has its own formal and administrative requirements.[38]

35. For companies wishing to bid under the REIPPPP, Eskom has prepared quite a comprehensive guide, detailing or pointing to further information for each step of the process, which can be found on http://www.eskom.co.za/c/73/info-site-for-ipps/
36. Additional voluntary carbon certification standard for projects with broad socio-environmental benefits, adding value to project's the carbon credits.
37. Korthuis, 2012
38. Korthuis, 2012

2.6 Funding sources

2.6.1 National Funding Sources

The financial market in South Africa is well developed, with multiple finance institutions offering both debt and equity finance. At the same time, it has to be noted that many commercial funding sources in South Africa are currently going through a similar "learning" stage on the new technologies as did their counterparts during the first years of renewable energy market development in Europe.

SO FAR, BIOENERGY PROJECTS HAVE NOT ATTRACTED MUCH FUNDING, MAINLY BECAUSE:

- **Projects tend to be quite small (in the order of kWs or at the most few MWs) and therefore cannot provide sufficient returns given all the associated costs. As a rule of thumb, projects valued at less than 100 mio ZAR find it very difficult to attract commercial funding (without any other form of support).**
- **Project developers do not have enough cash/ cannot attract sufficient equity and/ or they are not prepared to dilute their stakes to bring in some capital.**
- **Not many projects have been initiated in South Africa in the field of bioenergy, hence there is very limited experience with their development.**

Having noted this, there are clearly some institutions more eager to finance renewables, and there are also some with an exclusive mandate to provide funding to them. In addition, development finance is available and often used to close the gap to reach financial close. Here is an (non-exhaustive) overview of the main South African funding sources that are known to provide finance to renewable energy developments in general (but not necessarily to biomass in particular):[39]

TABLE 6: OVERVIEW OF MAIN NATIONAL FUNDING SOURCES FOR RENEWABLES

INSTITUTION NAME	TYPE OF FUNDING	NOTES
BANKS		
Standard bank www.standardbank.co.za	debt	No biomass/biogas projects yet in its portfolio, but open to a suitable opportunity.
Nedbank www.nedbank.co.za	debt	Financed one of the few commercial biomass projects in the region.
UFF Agri Asset Management www.uff.co.za	equity	Part of the Old Mutual Group; focuses on agricultural sector in Africa.
The Development Bank of Southern Africa (DBSA) www.dbsa.drm-za.com	grants, debt	Has a mandate to support RE projects in the region.
PRIVATE INVESTMENT FUNDS		
Kensani Capital www.kensanicapital.co.za	equity	Investment holding company for the economic upliftment and empowerment of women in South Africa; dedicated focus on the Southern African infrastructure sector including renewable energy.
Inspired Evolution Investment Management (IEIM) www.inspiredevolution.co.za	equity	IEIM is managing the Evolution One Fund, a 10 year fund (started in 2009) approved by the African Development Bank, worth 100 million ZAR and focused on clean energy and sustainable technologies across southern Africa (SA should account for 60-75% of the fund's overall investments).
The Metal Industries Benefit Funds Administrators (Mibfa) www.mibfa.co.za/	debt	Mibfa recently announced a 2 billion rand fund for the provision of debt finance for REIPPPP projects; no other information is available at present.
GOVERNMENT FUNDS		
The Industrial Development Corporation (IDC) www.idc.co.za	equity, debt, guarantees	Is a government fund aimed at investing in development of domestic industry, including renewables.
Department of Trade and Industry www.thedti.gov.za	grants	The DTI's Manufacturing Competitiveness Enhancement Programme (MCEP) offers grants to projects which have a BEE level 4 contribution.
National Development Agency (NDA) www.nda.org.za	grants	Not explicitly focused on energy but often offers grants to projects with strong positive social impacts.
The Green Fund www.sagreenfund.org.za	grants, loans (depending on thematic window)	Established by the Department of Environmental Affairs (DEA) and managed by DBSA, it contains an initial allocation of R800 million and dispenses funds through various thematic windows and invests across one or more project stages through a number of instruments.
The Drylands Fund www.dbsa.org/Projects/DrylandsFund/Pages/default.aspx	not clear	Another partnership between the DEA and the DBSA, it is primarily a pro-poor rural development fund, but could be of interest to projects involving distributed feedstock production.

The bottom line of every investment decision is of course expected returns. For projects aiming to be part of the current REIPPPP, investors (in appropriate size projects) can expect project level real internal rates of return (IRRs) of between 14-17%.[40] Debt from commercial lenders will have higher interest than in Europe, however there are several finance institutions offering concessionary loans, with very favourable conditions.

39. The National Business Initiative (NBI) in South Africa has recently published a report on climate finance sources available in South Africa and barriers to accessing them, which could be of interest to projects with a strong climate mitigation.
40. Krige, 2012

2.6.2 International Funding Sources

A number of international finance institutions, both banks and equity funds of various sizes and investment scope are present in South Africa, some even with strong mandates to support renewable energy projects. Besides private, commercial funding sources, some governments are also establishing a presence as funding entities by establishing own special-purpose funds, or teaming up with existing local funding institutions.

The Dutch Government has made a number of (financial) instruments available to assist Dutch businesses enter the South African market. For more information please contact zuid-afrika@info.agentschapnl.nl or visit www.agentschapnl.nl/programmas_regelingen

Another example is the US Government. In November 2012, three US Government agencies have teamed up to establish a Clean Energy Development and Finance Centre (CEDFC)[41] in Johannesburg which is supposed to support the development of renewable energy projects across sub-Saharan Africa. The CEDFC will operate from the US Consulate General. In addition, the US Ex-Im Bank recently concluded a $2 billion declaration of intent agreement with South Africa's IDC, with the specific intention of supporting energy projects.[42]

TABLE 7: OVERVIEW OF MAIN INTERNATIONAL FUNDING SOURCES FOR RENEWABLES

INSTITUTION NAME	TYPE OF FUNDING	NOTES
MULTILATERAL BANKS & FUNDS		
Clean Energy Development and Finance Centre (CEDFC)	not clear (CEDFC still under development)	The CEDFC will provide technical and financial support for renewable energy and gas projects while promoting US private-sector participation in the sector.
GEF 5 Trust Fund special climate change window	grants, other forms of concessional finance	Projects have to have a climate adaptation component.
African Carbon Asset Development (ACAD) Facility	grants	South Africa is a target country; local partner is Standard Bank in Johannesburg.
Africa Enterprise Challenge Fund (AECF)	grants and concessionary loans	AECF is running the REACT programme, which is a special funding window to incentivise private sector investment in clean energy.
Green Climate Fund	grants and concessional loans	Not yet operational; should include private sector facility that enables it to directly and indirectly finance private sector.
US Export-Import Bank	debt	Renewable Energy Programme with more accessible terms for renewable projects; project must include US technology import.
African Development Bank Sustainable Energy Fund for Africa (SEFA)	grants, equity	Aimed at enhancing commercial viability and bankability of smaller-size renewable energy and energy efficiency projects; two funding windows (dates yet to be released).
BILATERAL AGENCIES/ FUNDS		
Agency NL	subsidies, loans and grants	AgencyNL runs several programmes for support of innovative biomass projects, biomass imports to NL and private sector investment in target countries.
DOEN Foundation	subsidies, debt	Dutch Foundation, has a programme that promotes sustainable biofuels and bioenergy for local communities (FACT Programme).
FMO Sustainable Energy Strategy	equity, debt and guarantees	FMO is the Dutch development bank with a presence in SA; its Sustainable Energy Strategy Fund is focused on biomass projects, however in South Africa FMO will only consider funding projects using biomass waste as feedstock, to avoid any food vs fuel issues.[43]
Germany International Climate Initiative (ICI)	grants	South Africa is one of focal countries.

41. http://www.ustda.gov/news/press-releases/2012/SubSaharanAfrica/SouthAfrica/SouthAfricaCEDFC_FactSheet_112812.pdf
42. http://www.engineeringnews.co.za/article/us-moves-to-set-up-joburg-finance-hub-for-clean-energy-projects-2012-11-29
43. Personal communication with FMO office South Africa.

2.6.3 Additional Sources of Finance & other support

Local renewable energy projects can also make use of carbon finance, although several restrictions do apply. The CDM is not as attractive as it used to be, because as of 2012 new Certified Emission Reductions (CERs) can only be awarded to projects in least developed countries, and in any case the current CER price is too low[44] to provide any significant support to most projects. Having noted that, small-scale projects delivering a substantial development dividend, may earn a premium under an additional value added standard (i.e. the Gold Standard[45]). This can be the case under a CDM or voluntary certification scheme. Regardless of the carbon market segment targeted, the expected revenues from climate finance should be carefully weighed with the costs associated with developing carbon certification under any chosen scheme.

New climate finance mechanisms are still under discussion within the international climate negotiation framework, but will most likely become operational no earlier than 2015 and include (credited) NAMAs (Nationally Appropriate Mitigation Actions), NMMs (New Market-based Mechanisms), and REDD+ (Reducing emissions from deforestation and forest degradation and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks).[46]

In addition to the above mentioned market-based sources of climate finance, there is also a number of non-market based sources more specifically targeted at biomass projects, usually in the form of multilateral or bilateral funds (of other funding entities) that provide grants or loans at favourable conditions to projects that deliver additional (social and/ or environmental) benefits. They can either have a global scope (e.g. the Global Environment Facility Trust Fund), or focus specifically on one country or on a region (e.g. the African Carbon Asset Development Facility). Requirements and conditions to apply for funding under these funds can vary greatly, so project developers are advised to approach the funds directly and discuss the eligibility of their projects with the fund managers.[47]

Finally, it is worth mentioning that a number of donor funded technical assistance programmes is available to clean energy projects, one of the larger ones being the Energy Sector Programme by the Regional Economic Growth Office of USAID Southern Africa, which supports initiatives focused on: 1) adaptation, 2) clean energy and 3) sustainable landscapes.[48]

44. In mid 2012, secondary (i.e. issued) CERs were trading at around 5 EUT/t CO2eq. New (unissued) CERs based on forward contracts fetch an even lower price.
45. http://www.cdmgoldstandard.org/
46. For a complete overview of market and not-market based climate finance options for biomass projects in South Africa see Korthuis & Mijer (2012): Climate Finance for Biomass - An inventory of climate finance options and a review of overlaps with biomass sustainability certification.
47. Korthuis (2012)
48. Africa Business Group, 2012

2.7 Broad Based Black Economic Empowerment

IN SUMMARY, COMPANIES ARE ASSESSED ON HOW MUCH THEY CONTRIBUTE TO THE FOLLOWING SOCIO-ECONOMIC PARAMETERS:

- **(non-white) ownership (max 20 points)**
- **(non-white) management control (max 10 points)**
- **employment equity (max 15 points)**
- **skills development (max 15 points)**
- **preferential procurement (max 20 points)**
- **enterprise development (max 15 points)**
- **socio-economic development initiatives (max 5 points)**

49. Kruger, 2011
50. I.e. value-added processing.
51. Department of Trade and Industry, 2012

South Africa's policy of broad-based black economic empowerment (B-BBEE) is part of the Government's inclusive growth strategy and a moral imperative to rectify the wrongs of the Apartheid regime, which excluded the non-white population (that is black, Indian and coloured, together often referred to as the "historically disadvantaged" population) from asset ownership and engagement into the higher levels of economic activity. Companies looking to do business/ to engage with the SA Government should be aware of this requirement. Several relevant documents and guidelines can be found on bee.b1sa.co.za/. For all practical purposes, the B-BBEE codes in South Africa apply to all government departments, NGOs (non-governmental organisations), all public and private companies (both those listed on the Johannesburg Stock Exchange and those that are AltX listed), close corporations, Article 21 (non-profit) companies, incorporated companies, external companies, sole proprietors and partnerships.[49] B-BBEE is measured by means of a balanced scorecard, which is administered by the BEE unit of the Department of Trade and Industry (DTI).

Each of the listed elements has a pre-determined weight in points which are used to calculate a B-BBEE score and determine its B-BBEE contributor status (from Level One, which is the highest possible, to the lowest, which is Level Eight). If a company does not reach a certain minimum score it is considered Non-compliant. In terms of public procurement, the higher the B-BBEE status a company has, the better, and several private stakeholders (including funding institutions) are now also looking to engage with organisations with a high B-BBEE status.

The empowerment indicators against which an enterprise is assessed, are very similar to the ones discussed above (with some adjustment, for example "ownership" is explicitly defined as "land ownership" and "socio-economic development" is elaborated as "Rural Development, Poverty Alleviation and Corporate Social Investment"), however their relative weights are somewhat different to reflect the difference in priorities within the agriculture sector.

A SEPARATE SET OF GUIDELINES (CALLED AGRI BEE SECTOR CODES) EXIST FOR ENTERPRISES ACTIVE IN THE AGRICULTURAL SECTOR. THESE APPLY TO ANY ENTERPRISE WHICH DERIVES THE MAJORITY OF ITS TURNOVER FROM:

- **The primary production of agricultural products;**
- **The provision of inputs and services to enterprises engaged in the production of agricultural products;**
- **The beneficiation of agricultural products whether of a primary or semi-beneficiated form; and**
- **The storage, distribution, and/ or trading and allied activities related to non-beneficiated agricultural products.**[51]

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There are also some exceptions to the rule: The B-BBEE Act makes a distinction between an exempted micro-enterprise (EME) with a total revenue of R5 million or less; a qualifying small enterprise (QSE) with total revenue of between R5 million and R35 million; and a start-up enterprise, which is measured as an EME for the first year of formation or incorporation. An EME is deemed to have a B-BBEE status of level 4 or level 5 in instances where more than 50% is owned by historically disadvantaged people. A QSE must select any four of the seven elements of the scorecard for measurement to determine its compliance.

To comply with the B-BBEE policy, companies often employ the services of Verification Agencies (VAs). However, verification practices can vary substantially from agency to agency, resulting in confusion in the market. From February 2010, only certificates issued by accredited VAs are acceptable in the market.

While the B-BBEE policy is not without its critics, it is widely accepted in South Africa, and there are several BEE investment funds that can be approached to provide “black equity” to new business ventures in the country.

For Dutch bioenergy businesses, the BEE requirement is not likely to be applicable in many cases, as there are not many opportunities for meso-scale bioenergy operations. As mentioned, if a company wishes to set up a local branch, it should keep in mind that small business (with revenue less than 5 million ZAR/y) are exempt of the BEE requirement. At the other end, technology partnerships on a larger scale, are most likely to be forged between Dutch companies and existing producers of energy services in South Africa, who should all have their BEE obligations already in place. In any case, companies are advised to study their situation attentively and take every reasonable measure to not overlook any possible BEE requirement on their operations in South Africa.

3 BIOMASS **BUSINESS OPPORTUNITIES** IN SOUTH AFRICA


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3.1 Work method and stakeholders interviewed

In order to understand the business opportunities in the bioenergy sector in South Africa, first an inventory was made of the current situation. This was done by means of a desktop analysis as well as interviewing a selection of important players in the industry. This information was subsequently compared to the bioenergy valorisation scheme (see Figure 3) which helped identify a number of opportunities for the bioenergy businesses in the Netherlands, both in the production of biomass and in the conversion technologies of biomass into biofuels, process heat and power.

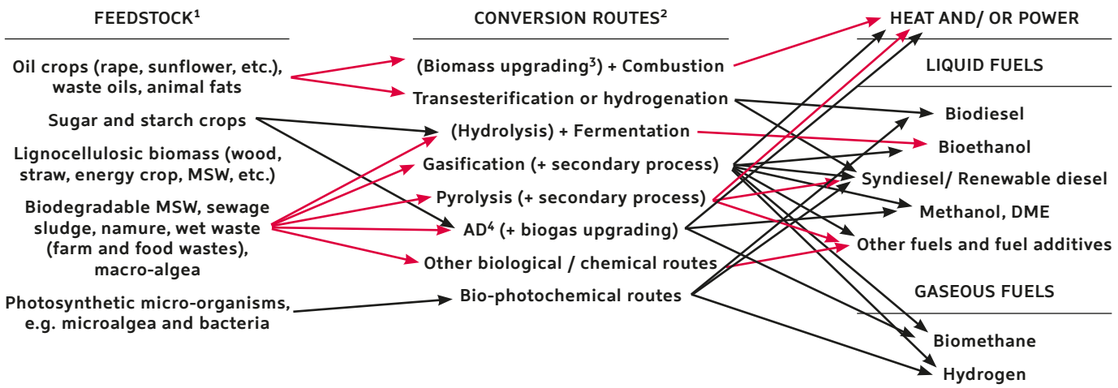
Stakeholders in the biomass sector were interviewed in order to assess the biomass market size and sector readiness in South Africa.

WITHIN THE LIMITED TIME FRAME OF THIS MARKET ENTRY STUDY THE FOLLOWING SELECTION WAS MADE FOR THE INTERVIEWS:[52]

- **Eskom, main electricity provider in South Africa with an interest in co-firing biomass in pulverized coal power stations to reduce GHG emissions as well as supporting alternative energy initiatives in rural areas.**
- **Sasol, producer of synfuels, polymers, chemicals and solvents, known for its coal-to-liquid and gas-to-liquid technology and interested to reduce GHG emissions via biomass-to-fuel and/or biomass-to-electricity technologies.**
- **Sappi, owner of 45% of the plantation forests in South Africa and major global producer of paper & pulp and cellulose with an interest in optimizing biomass utilization from side and residual streams in their mills both for environmental and economic reasons.**
- **Tsb Sugar operates three sugar Mills in South Africa and uses cane fibre to generate electricity and process heat and explores the options to convert plantation residue into charcoal and bio-oil.**
- **BioGreen, the largest biodiesel producer in South Africa using waste cooking oil with production facilities in a few provinces.**
- **Bio2Watt, developing commercial biogas plants using agricultural and abattoir residue and manure as feedstock (co-financed by Agency NL).**
- **Cape Advanced Engineering, an engineering company with longest presence on the biogas market in South Africa.**
- **Dalin Yebo, a technology developer and provider that has biomass valorisation as its core for production of energy and chemicals.**
- **UFF Agri Asset Management, a specialized investment management company with a dedicated focus on the agricultural sector in Africa.**
- **SANEDI, the implementation agency for the DoE for non-nuclear energy topics.**
- **Stellenbosch University, the Centre for Renewable and Sustainable Energy Studies (CRSES) as the major institute for biomass research and education in South Africa.**
- **The Southern African Bioenergy Association, the longest running bioenergy industrial association in the region.**

3.2 Bioenergy value chain

FIGURE 3: BIOENERGY VALUE CHAIN[53]



Note 1: Parts of each feedstock, e.g. crop residues, could also be used in other routes
Note 2: Each route also gives co-products
Note 3: Biomass upgrading includes any one of the densification processes (pelletisation, pyrolysis, torrefaction, etc)
Note 4: AD = Anaerobic Digestion

EXAMPLES OF PRODUCTION SCALES IN EACH OF THESE THREE PILLARS ARE:

- **Small scale feedstock production – sugar cane small grower with 2ha producing 10 tons of sugar in addition to 100 tons 2nd generation biomass per annum.**
- **Medium scale conversion – pyrolysis plant producing 5 tons bio-oil per hour from 5 000ha of plantation forest for off-grid production of electricity and process heat.**
- **Large scale distribution – 10% co-firing in electricity production for the national grid in a 2.400MW power station requiring 100.000 tons torrefied biomass per annum.**

For a good assessment of the market potential for bioenergy one needs to consider the complete value chain as shown below.

The three pillars of the chain are feedstock production, biomass conversion and end product specification and distribution. In principle, any of the above chains can be of any production scale.

In a future bio-based economy the bioenergy value chain will be integrated in the biorefinery model and include the production of bio-chemicals. These usually have a higher added value than bioenergy end products. For a sustainable bio-based economy it is required that the complete feedstock is used, therefore the optimum choice will be a mix of energy and refinery products depending on the type of feedstock used and the market requirements.

3.3 Opportunities in biomass production

Currently, coal is the dominant energy source in South Africa for the production of electricity and synfuels as well as in the domestic metallurgical sector with an internal consumption of almost 200 million ton per annum. In order to comprehend the South African situation the table below shows the national production scales of coal and the four main biomass residues.

TABLE 8: ANNUAL PRODUCTION OF COAL AND MAIN BIOMASS RESIDUE ENERGY CARRIERS IN SOUTH AFRICA

ENERGY CARRIER	RSA PRODUCTION	LHV	THERMAL POWER	REMARKS
	mio ton/a	GJ/ton	GW_{th}	
Coal	281	28	175[a]	70% internal consumption, 30% exported.[54]
Wood residue	1	12	0.4	From 23 million m3 wood produced on 1.2 million ha plantation forest.[55]
Maize residue	55	12	21	Average 2007-2011, from 12 million ton maize produced on 3 million ha agricultural land, assuming cobs contain 18% kernels and 82% residue.[56]
Cane residue	17	12	6.5	Average 2007-2011, from 2 million ton sugar produced on 0.4 million ha agricultural land.
Manure and litter	1.3	15	0.6	Corresponding with 5.500 GWh/year, produced by cattle, pigs and poultry.[57]

LHV=Lower Heating Value of harvested biomass
a. internal consumption only

To replace coal consumption substantially, mainly maize residues and sugar cane residues are of interest. In South Africa an estimated 32 million ton of coal per annum can be replaced by biomass or 16% of the current internal use. Additional interesting feedstock streams (<1 million ton/a) include black liquor from the paper and pulp industry, slaughterhouse waste, alien vegetation and residues from other agricultural products that are produced in South Africa on smaller scale than maize, such as soybean, wheat and grain sorghum. Given that the operating scale of most bioenergy plants is typically 100 000 ton per annum or less, based on the above figures one can conclude there are currently ample opportunities for local biomass supply from agricultural residues and other wastes to feed these plants in South Africa. However, when planning the use of plant residues as bioenergy feedstock, care should be taken to maintain an adequate level of organic

52. Several of the interviewed stakeholders have provided descriptions on their main activities and biomass ambitions, which have been compiled as an Annex to this report and can be obtained by the Embassy in Pretoria upon request.
53. E4Tech, 2009
54. Index mundi (2013)
55. IEA (2007)
56. DAFF (2012)
57. DME (2003)

content in the soil in order not to reduce the product yield (since most soils in South Africa are already relatively low in organic content).

Looking into the longer-term future development of the national bioenergy sector, it must be realised that increasing the country's agricultural and forestry sector substantially is limited by water scarcity. According to UNESCO guidelines, South Africa is a water-stressed country, which means that expansion of forest plantations or agricultural production to increase availability of biomass for energy production is limited. Most of the biomass production is currently located in the north-eastern and eastern parts of the country.

The water situation in neighbouring SADC countries is quite different. As a result the average forestation cover in SADC is 33%, compared to only 7% in South Africa (see table 9). Optimum expansion opportunities of forest plantations in the region for biomass production are clearly in SADC countries like Angola, DRC, Mozambique and Zimbabwe. Despite this difference about 50% of existing forest plantation area is still in South Africa.

TABLE 9: FOREST COVER AND FOREST PLANTATION IN SADC COUNTRIES[58]

COUNTRY	LAND AREA (000 HA)	FOREST COVER (000 HA)	% OF LAND AREA	PLANTATION AREA (000 HA)
Angola	124 670	69 756	56.0	141
Botswana	56 673	12 427	21.9	1
D.R. Congo	226 705	135 207	59.6	97
Lesotho	3 035	14	0.5	14
Malawi	9 408	2 562	27.2	112
Mauritius	203	16	7.9	13
Mozambique	79 409	30 601	39.0	50
Namibia	82 329	8 040	9.8	0
Seychelles	45	30	66.7	5
South Africa	121 758	8 917	7.3	1 554
Swaziland	1 720	522	30.3	161
U.R. Tanzania	88 408	38 811	43.9	135
Zambia	74 339	31 246	42.0	75
Zimbabwe	38 685	19 040	49.2	141
TOTAL	907 387	357 189	32.95	2 499

COOPERATION OPPORTUNITIES IN BIOMASS PRODUCTION:
THE NETHERLANDS HAS AN IMPRESSIVE RECORD IN THE AGRICULTURAL AND WATER SECTORS. OPPORTUNITIES FOR BUSINESSES WISHING TO EXPORT THEIR KNOW-HOW AND TECHNOLOGIES FOR BIOMASS PRODUCTION IN SOUTH AFRICA INCLUDE:

- **Water management and irrigation – the Water Research Commission, WRC, has defined Water Utilization in Agriculture as a key strategic area to meet the needs of present and future generation subsistence and commercial farmers. In this respect it is important to refer to the existing cooperation between the Water Institute South Africa (WISA) and the Netherlands Water Partnership (NWP) in the South-Africa – Netherlands Water network.**[59]
- **Soil improvement – in the Netherlands, biochar produced by slow pyrolysis of residual biomass is being investigated for its qualities in soil improvement in combination with or to replace compost (Fertiplus project**[60]**) and could be useful for semi-arid regions such as the Northern Cape province.**
- **Land reform – the Department of Rural Development & Land Reform has developed a strategic plan for agrarian transformation,**[61] **which opens investment opportunities for sustainable small and large scale farming.**
- **Exploitation of until now hardly exploited sources, such as:**
  - **Alien vegetation; while combating bush encroachment in vulnerable ecologic systems large quantities of biomass could be produced for further beneficiation in the energy sector. Efficient harvesting equipment needs to be developed.**
  - **Dry leaves of hand-cut sugar cane; potential is in the same order as bagasse but effective mechanical separation technology still needs to be developed.**
  - **Agricultural waste, such as maize residues and soybean residues, are more abundant in South Africa than sugar cane residues.**
  - **Abattoir residues for biogas production.**
- **Breeding and genomics to develop drought tolerant plants for semi-arid regions in the western part of South Africa.**
- **Opportunities in forestry and agriculture in SADC countries outside South Africa in order to increase the biomass availability.**
- **Certification - standards and certification methods for sustainable production of export biomass need to be tested for present and new applications; Dutch consultancies already have experience with certification processes for compliance with EU regulations on biomass sustainability and could transfer their knowledge to local consultants and verifiers.**

58. Source: FAO (2002). Forestry Outlook Study for Africa Report
59. http://www.waternetwork.co.za/
60. www.fertiplus.eu
61. DRD&LR, 2011
62. Zietsman, 2011

A substantially higher sustainable biomass production rate in SADC could also open markets for biomass export both between SADC countries and to the Netherlands in order to comply with the EU regulations on renewable energy.

3.4 Opportunities in biomass conversion

In this section the most interesting thermal, chemical and biochemical processes that are considered mature or close to commercialisation in the Netherlands and could potentially be exported to South Africa over the short to medium-term will be discussed in some detail. The sub-sector descriptions that follow are not uniform across the technologies covered. This is a direct consequence of the fact that several technologies at the brink of commercialisation in the Netherlands, are not being developed in South Africa, hence very little information is available on them in the South African context. This does not mean there are no opportunities to promote these innovative technologies in the local market once they reach commercialisation, and their pioneering companies are advised to keep a close look at the developments in the South African bioenergy sector to make the most of the first mover advantages.

3.4.1 Biogas

Biogas (methane) can be produced from biomass either via anaerobic digestion or thermal conversion (gasification) to synthetic natural gas (SNG). Thermal biomass gasification is described in section 4.4.6. Hence, the focus in this section is on anaerobic digestion.

South Africa's biogas sector is still a very young industry. Its beginnings are largely linked to the Government's 2003 White Paper on Renewable Energy, which sees biomass, especially organic waste and alien vegetation, as important untapped local sources of renewable energy.[63]

Initially, the sector focused on small-scale[64] (up to 20 m3) installations, however despite the abundant feedstock, Africa in general and South Africa in particular lag behind Asia in the development of domestic biogas. Following the announcement of the REFIT programme in 2009, the sector started gearing up for possible commercial size projects (>200kW), several EIAs and feasibility studies were conducted, but when the REFIT was finally published at the end of 2009, it appeared that biogas was completely excluded from the programme, without any explanation of the rationale behind this. Even though the REIPPPP brought biogas back into policy focus, its minimum 1MW project size requirement effectively excludes the vast majority of potential biogas developments (if size requirement is reduced to 0.2MW, it can be done at a single waste source, a 1MW project will require significantly more logistics to deliver sufficient amounts of feedstock). At the same time, the initial sunk costs (mainly in the form of application fees) make bidding under the REIPPPP prohibitive, even for biogas projects reaching few MWs of capacity. Due to all this, there are presently less than 200 biodigesters in SA, 90% of which are very small-scale domestic applications.[65] Commercial applications have nevertheless slowly started developing (outside the REIPPPP), mainly in the form of 2-5MW projects. At the beginning of 2013, there is about 12.5MW of new capacity in the pipeline.[66]

In South Africa, one can find several different installation designs, from concrete fixed-dome biodigesters, to (locally manufactured) pre-fabricated plastic ones, to (imported) inflatable ones. It is as yet not clear that a single technology dominates the market.

SUBSECTOR VALUE CHAIN

There is a significant amount of feedstock available for anaerobic digestion, the most easily accessible one is animal waste from feeding lots (at low or no cost). South Africa has a large agricultural sector, with an abundance of plant waste (beyond what is mentioned in Table 6), often quite homogeneously concentrated in certain areas (e.g. like grape residues in the Western Cape, sugar cane residues in KwaZulu Natal), which allows for "regional" plant optimisation, that can be rolled out in the area. A potentially very important source in the future could be indigenous grasses.

The limited number of commercial installations mainly use imported technology or parts,[67] which were assembled locally. Engineering know-how exists locally, but is limited to a small number of companies (mentioned below in the "main actors" paragraphs).

The main end product of biogas in South Africa is electricity. Even though it is produced through co-generation, there is rarely a productive outlet for the heat that is also produced. Slurry (the by-product of anaerobic digestion) is apparently not capitalized on as much as it could be, most likely because of insufficient awareness of its value as a fertilizer in the agricultural sector.

SUB-SECTOR ECONOMICS

Despite the fact that there is abundant feedstock, critical shortage of electricity, and sufficient know-how to kick-start the sector development, it is currently very difficult to develop a financially sustainable project. Selling electricity to Eskom at its current whole-sale buy-back price (R0,5/kWh) is not a viable option, so at present, the only way to make a biogas project profitable is to sell the electricity to an on-site user (where electricity is generated) or arrange a wheeling construction to a not-too-distant user (the viability of the wheeling arrangement will of course depend on the project size and PPA with the user). However, at most sites where there is a readily available feedstock stream (i.e. animal waste at feeding lots) the demand for final energy (electricity and heat) is much smaller than the production capacity.

63. Another important potential feedstock which is not included in the White Paper, are indigenous grasses, which are found in abundance in the areas between Johannesburg and Durban and Johannesburg and Port Edward. Several estimates of the sector's potential conclude that if SA had a good support programme for this technology, biogas from non-food crops could provide power in the order of several GWs p.a. (personal communication with local biogas expert).
64. It is important to note that "size categorisation" for biogas installations is not uniform across sources; small-scale in literature usually refers to household-level installations, of up to some 20 m3 and usually involves no engine (biogas is used directly for cooking or lighting). In the same categorisation a 1MW commercial biogas-to-power project will be considered large, however the REIPPPP for instance considers projects up to 5MW as "small".
65. Tiepelt, 2013
66. Smith, 2013
67. Often from Germany or Australia.

Typical size biogas projects in the region (<5MW) struggle to raise commercially available finance, and often rely on donor funding or special support programmes for this type of projects. As a rule of thumb projects smaller than 3MW, can only be viable if there are no grid connection costs involved, and are rather focused on co-generation for on-site use.

In addition to funding sources mentioned in section 4.2, there are additional incentives available specifically for biogas. Apparently, Eskom's rebate scheme was extended to biogas in 2012. The DTI issued a grant scheme, geared towards the manufacturing sector.[68] Furthermore, the South African Revenue Service (SARS) depreciation allowance gives agricultural concerns the possibility to depreciate renewable energy capital expenditure at a rate of 50% during year 1, 30% during year 2 and 20% during year 3.

MAIN ACTORS SPECIFIC TO SUB-SECTOR

Presently, there are some 14-15 biogas companies in the country. The most notable companies operating in the small scale (up to 20 m2) section of the market are Agama, BiogasSA, TradePlusAid. On the medium scale (few hundred kW) players include BiogasSA, Cape Advanced Engineering, Farm Secure.[69]

A special mention should be made of the company Bio2Watt, which is currently developing one of the very few commercial biogas projects in South Africa (also the biggest one using animal waste as feedstock), with the support of Agency NL. They have an additional 6 projects in the pipeline, making them one of the "biggest" biogas developers in South Africa and pioneers in developing biogas projects on the MW scale.[70]
Its Bronkhorstspruit Biogas Project required about 5 years to secure all necessary permits and is only now reaching financial close (with IDC providing the debt), however subsequent projects should take much less time.

Another company that has been active in the meso-scale section of the market is Cape Advanced Engineering. They currently have 4 operational biodigesters in place at intensive pig farms, together totalling just over 1MW of installed capacity between the Limpopo and Gauteng province.

Between 2003 and 2011 there were several agents of German, Italian and Dutch companies in South Africa, trying to sell European technology, which was not viable at the time (with generation costs of around R3/kWh).[71] At present, it has been noted that German companies are turning to the SA market again.

Finally it is worth repeating that the developing biogas sector in South Africa has organised itself under the umbrella of a new industrial association called SABIA (South African Biogas Association), which is a very active body engaging with the Government to further the development of the sector. They are also currently working with the SABS to develop industry standards for everything from technology to appliances.

68. http://www.bdlive.co.za/business/energy/2013/02/15/new-biogas-association-upbeat-on-growth-potential; however, at the time of writing, ESKOM's Integrated Demand Side Managament Plan website (also covering its rebate program) makes no mention of biogas http://www.eskomidm.co.za/funding-options
69. Personal; communication with African Centre for Cities biogas expert.
70. For more information about Bio-2Watt's Bronkhorstspruit Biogas Project that was partly funded by NL Agency, see http://www.agentschapnl.nl/en/programmas-regelingen/sustainable-biomass-projects
71. Personal communication with local biogas technology provider.
72. http://www.bdlive.co.za/business/energy/2013/02/15/new-biogas-association-upbeat-on-growth-potential
73. http://www.info.gov.za/view/DownloadFileAction?id=97351
74. There is no indication on when the expected specific regulation governing the disposal of organic waste will be implemented, but its promulgation can be tracked on http://www.info.gov.za/view/DynamicAction?pageid=528
75. Personal communication with local biogas expert.

FUTURE TRENDS

Industry experts estimate that 2.500MW could be generated through biogas in South Africa.[72] At present, several feasibility studies are known to be conducted. The pull for new biogas developments in SA is the rapidly increasing electricity price (though biogas-electricity is still not competitive compared to the grid) and a need to improve waste management. The Waste Act of 2008 (published in the Government gazette in March 2009[73]) is expected to eventually start banning certain types of waste from landfills (i.e. abattoir waste), that will need to be disposed of otherwise.[74] It therefore seems that the South African biogas industry might be birthed out of waste management issues in equal measure as energy generation need.

COOPERATION OPPORTUNITIES

The slow but steady development of meso to large(er) scale projects offer collaboration opportunities. However, it is important to note that European technology (and digester design) is often specified for European conditions, which are different from those in South Africa (for example, in Europe, high level of automation is desirable, because labour is expensive and capital is relatively cheap, whereas in South Africa the opposite is true). This means that European technology cannot easily be exported to South Africa and installed as such, but will need to be adapted to the local context.[75] Within this context, biogas companies in SA are often looking for a technology partner and an equity investor.

Because the Dutch have extensive experience with fermentation of different feedstocks, an important opportunity could be in the pre-treatment of different types of organic waste for digesters, which would broaden the feedstock base of the sector, as well as plant optimisation for different co-digestate combinations, since most of the local experience is based on animal manure alone. Another important opportunity would be recovering nutrients from digestate, which is currently not sufficiently valorised. Once the announced waste regulation comes into force, the realisation of complete farm level biogas installations will also become interesting, because the local market is far from saturated and the existing technical capacity will be insufficient to service the large South African animal husbandry sector.

3.4.2 Fuel ethanol

The annual production rate of fuel ethanol per continent for 2012 is shown in table 10, revealing that this market in Africa is underdeveloped. The most advanced country in terms of fuel ethanol use is Malawi, which has a 20% biofuel obligation, mainly based on bioethanol from C-molasses.

TABLE 10: FUEL ETHANOL PRODUCTION IN 2012

MILLIONS OF GALLONS	CONTINENT
13.768	North & Central America
5.800	South America
5.577	Brazil
1.139	Europe
952	Asia
555	China
4.490	Canada
71	Australia
42	Africa

Source: RFA,F.O. Lichts

The main feedstock considered for bioethanol in the region is sugar cane, either because of its sugar, C-molasses or the ligno-cellulosic cane and leaf residues. The main sugar producers in South Africa are Tongaat-Huletts, Illovo and Tsb Sugar operating in KwaZulu-Natal, Mpumalanga and Eastern Cape.

Production of 1st generation fuel ethanol from sugar fermentation and polysaccharides hydrolysis are established technologies.[76] The challenge for the sector right now is to commercialise technology for the conversion of lignocellulosic biomass into 2nd generation biofuels in order to bypass the food vs fuel dilemma and expand the feedstock base.

The bioethanol sector using 1st generation technology in South Africa is not yet developed. At the moment there are no fuel ethanol plants using biomass as feed stock in operation, however, there are two large scale developments in the pipeline. One is the recently announced fuel ethanol production facility by Mabele Fuels[77] in Bothaville, a commercially funded venture to be in operation in 2014, using grain sorghum produced by commercial and emerging farmers, and technology providers from China (CHMC) and Australia (Vogelbusch). The second one is to be based in Cradock, in the Eastern Cape. Most of the funding is to be provided by the IDC and its aim is to organise the complete value chain under government supervision and support.
A combination of commercial and emerging farmers are to supply sugar beet to the local bioethanol plant. The project kicked-off in 2007 and has to-date been subject to significant delays, but the government is still determined to implement it.

FUTURE TRENDS
Expansion of bioethanol production in South Africa is feasible, but in view of government restrictions of using maize, would require a certain amount of changes in local farming practices. Grain sorghum is a drought resistant crop, indigenous to Africa and believed to be well suited for agriculture in the region.
The current production rate in South Africa is only 200.000 ton per annum.[78] A more substantial introduction of grain sorghum based fuel ethanol would require a considerable change in farming practice. Sugar beet is another potentially interesting feedstock for first generation bioethanol. Its yields in certain areas of South Africa (for example in the Easter Cape) are much higher than in Europe, however there is less experience with farming it.

Sweet sorghum is considered as the most promising future agricultural feedstock for bioethanol production.
The Agricultural Research Council[79] (ARC) in Pretoria participates in the Sweet Fuel project of the EU, which identified bagasse from sugar cane and sweet sorghum the two main feedstocks for 2nd generation fuel ethanol. Both are abundantly produced in Southern Africa. Another important feedstock source identified are woody residues from forestry, however unused wood residues are currently less abundant.

THE MAIN OPPORTUNITIES FOR THE DUTCH INDUSTRY ARE IN THE SUPPLY OF:
- **Fermentation reactor technology.**
- **Energy efficient separation technology ranging from heat integrated distillation at the front end and membrane technology for final fuel ethanol dewatering.**
- **Development of enzymes for bioethanol production from lignocellulosic biomass, abundantly available in South(ern) Africa.**

76. Cardona and Sanchez (2007)
77. http://www.mabelefuels.com/
78. Abstract of Agricultural Statistic, Department of Agriculture, Forestry and Fisheries (2012)
79. http://www.arc.agric.za/home.asp?pid=1

3.4.3 Biodiesel

The biodiesel sector in South Africa is faring a little better than the bioethanol sector. Nevertheless, with a lack of a suitable blending regime, the sector development is restricted to "voluntary" uptake of individual companies and their fleets. At present, most of the biodiesel in South Africa is produced from waste cooking oil.

MAIN ACTORS SPECIFIC TO SUB-SECTOR
BioGreen is the biggest producer of biodiesel in South Africa at the moment. The company was established in 2008 and follows a cradle-to-cradle approach, using waste cooking oil to produce biodiesel, while the main by-product of the conversion process, glycerine, is used as input in the production of fertilizer, hence helping the growth of the plants which will in turn be used as feedstock in the production of plant oil (for cooking).

The company is currently in an expansion phase. Besides running factories in Cape Town (up to 4000 l/day capacity) and in Port Elisabeth (up to 1000 l/day capacity), BioGreen is currently constructing two other factories in KwaZulu Natal and Gauteng.

LEVEL OF TECHNOLOGY
Biodiesel is mainly produced using standard trans-esterification process. BioGreen, uses a jet reactor to do this, with a few changes pioneered by themselves.

BIO GREEN PROCESS HAS THE FOLLOWING ADVANTAGES:
- **It takes only 6 hours to convert waste cooking oil into biodiesel.**
- **The process only uses heat up to 45 C°.**
- **It uses only 16% methanol (as opposed to 19 – 25%).**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SUBSECTOR VALUE CHAIN, DOMESTIC CONSUMPTION, EXPORT

While the uptake of biofuels in South Africa is negligible, BioGreen has developed a business model, which guarantees the off-take of its production. The company sells virgin cooking oil to restaurants, catering businesses and supermarket chains, buys-back their waste cooking oil from them at a market price, converts it into biodiesel, then sells most of it back to them to use in their own vehicles.

In 2012, the company produced about 290 000 litres of biodiesel, using about 260 000 litres of waste cooking oil. Despite having been approached several times with requests to export their biodiesel, BioGreen chooses to focus on the local market only. The company sells 100% biodiesel, and while some of its clients use it as such, it is more common for biodiesel in South Africa to be used as a blend (mainly 5%, sometimes up to 20%).

In addition, there are several small-scale "garage" biodiesel producers, however they do not operate on a commercial scale, so their activity is very difficult to quantify.

SUB-SECTOR ECONOMICS

The main cost component in the value chain is the cost of the feedstock: waste cooking oil is already becoming an increasingly scarce commodity. Its price has already increased from 0.5 – 1 ZAR/l in 2009 to 2 – 5,5 ZAR/l in 2013. Future increases are to be expected.

The main reason for this price hike is the demand from different users of waste cooking oil – the a growing number of very small-scale un-registered biodiesel producers, and companies that buy waste cooking oil, purify it, then sell it into poor communities again as virgin oil, a practice widely known to occur, but which so far the Government has failed to stop.

At present, the price of biodiesel in South Africa is 1 ZAR/l lower than the wholesale price of conventional diesel, which makes it an attractive alternative transportation fuel. Main users are supermarket chains and logistics companies with own vehicle fleets.

FUTURE TRENDS

BioGreen estimates there is about 28 mio litres of waste cooking oil produced in South Africa, and only about 3 mio l are currently converted to biodiesel. The waste-oil biodiesel market in South Africa could expand considerably if government succeeds in controlling the illicit practice of recycling waste cooking oil and puts adequate policy in place.

There are also some developments on the vegetable oil section of the biodiesel market that indicate some reason for cautious optimism. After years of turmoil, Coega[80] is expected to announce in 2013 the construction of two large plants to produce biodiesel from canola and soya. The plant will be owned by Rainbow Nation Renewable Fuels (RNRF), an offshoot of the National Biofuels Group of Australia. The canola plant will initially produce biodiesel for export to the European Union. Later it will likely be expanded to supply fuel to South Africa. The soya plant will be fully directed at supplying the South African fuel market.[81]

COOPERATION OPPORTUNITIES

The technology used in South Africa to manufacture the (limited) quantities of biodiesel from waste cooking oil is well-established and locally available.

On the other hand, production of larger quantities from vegetable oil will require imported technology and know-how to cover the complete production chain, as there is currently little local expertise and no local industrial scale production facility in operation. In addition to feedstock pre-treatment and conversion to biofuels, two important sections of the value chain that might require external expertise are the blending process and the logistics of collecting and storing feedstock, and storing and distribution of larger quanitites of biofuel. While the sector offers significant expansion opportunities, it requires permanent presence to establish and maintain working relationship with a large number of feedstock sources and final users (since at present, end users seem more interested in biodiesel than fuel companies).

80. The Coega Development Corporation (CDC) is a state owned entity mandated to develop and operate the Coega Industrial Development Zone (IDZ) which is located adjacent the modern deep water port facility, Port of Ngqura, see www.coega.co.za
81. http://mg.co.za/article/2013-04-05-00-biofuel-firms-persevernce-set-to-pay-off
82. Koppejan et al, 2012

3.4.4 Torrefaction for co-firing and co-gasification

A BIOMASS TORREFACTION PLANT TYPICALLY HAS THREE SECTIONS:

- **Drying of the feed material at 100-110 C°.**
- **Torrefaction by melting the lignin at 250-300 C°.**
- **Pelletisation and cooling to obtain the final end product.**

Torrefaction is a mild thermal pre-treatment step in order to increase the calorific value of the biomass. In addition, it converts the biomass from being hydrophilic to hydrophobic and thus resistant to degradation by rotting, which is important for storage. Torrefaction of wood reduces the weight by 30-50%, mainly depending on the water content of the wood, which considerably reduces transportation cost.

With proven production capacities up to 160,000 t/a (20 t/h)[82] torrefaction is considered a mature technology, although it still lacks a consistent track-record over several years of operation on an industrial scale. This is exacerbated by the fact that further up-scaling would lead to unacceptably high transportation cost from the biomass production location to the conversion site.

Different torrefaction technologies are being developed around the world and international competition is strong as is clear from Table 11.

At the moment, there are no torrefaction plants in operation in South Africa, although there are two large end users potentially interested in torrefaction, Eskom for co-firing and Sasol for co-gasification in order to reduce their GHG emissions. In 2012 Eskom expressed the ambition of a 60 000 tpa torrefaction plant for co-firing tests at the Arnot coal power station. Sasol recently did co-gasification tests with biomass on pilot scale.

A related technology is the production of charcoal, where more severe thermal treatment conditions are used.
In South Africa, charcoal has mainly been used in the consumer and the metallurgical sectors. A feasibility study undertaken by Tsb Sugar and its small growers led to the start up of a charcoal production facility using cane tops and green leaves; biomass that currently is not being used. The facility is to be set up in the Nkomazi area due to its potential for rural empowerment.[83]

TABLE 11: TORREFACTION TECHNOLOGIES AND TECHNOLOGY PROVIDERS WORLDWIDE[84]

REACTOR TECHNOLOGIES	TECHNOLOGY PROVIDERS
Rotating drum	CDS (UK), Torr-Coal (NL), BIO3D (FR), EBES AG (AT), 4Energy Invest (BE), BioEndev/ ETPC (SWE), Atmosclear S.A. (CH), Andritz , EarthCare Products (USA)
Screw reactor	BTG (NL), Biolake (NL), FoxCoal (NL), Agri-tech Producers (US)
Herreshoff oven/ Multiple Hearth Furnace (MHF)	CMI-NESA (BE), Wyssmont (USA)
Torbed reactor	Topell (NL)
Microwave reactor	Rotawave (UK)
Compact moving bed	Andritz/ECN (NL), Thermya (FR), Buhler (D)
Belt dryer	Stramproy (NL), Agri-tech producers (USA)
Fixed bed	NewEarth Eco Technology (USA)

FUTURE TRENDS

The major future challenge for most torrefaction technologies is to build a track record as proven technology which is sufficiently robust to handle a wide range of biomass and produce torrefied pellets with consistent quality. Only then will it be considered a fully “mature” technology and hence fit for export.

COOPERATION OPPORTUNITIES

The major opportunity for torrefied biomass for domestic consumption is in co-firing. In 2012, Eskom consumed 125 million tons of coal for electricity production. It is expected, that the first torrefaction plant servicing Eskom’s need for biomass for co-firing could be in operation by 2015. On the longer term, replacing 10% of the coal would require ± 15 million ton torrefied biomass per annum or 150 torrefaction plants of 100.000 tpa each. A rough estimate of the investment costs puts them in the order of 3.000 million Euros.

The second opportunity is in co-gasification at Sasol. As the coal consumption is roughly 1/3 of Eskom’s this torrefaction market is easily determined once the optimum biomass/ coal ratio is known.

At the time of writing, Eskom and Sasol did not yet announce a final decision on the preferred technology provider, which means this important opportunity might still be open to Dutch companies as well, although international competition is strong. Feasibility studies for the supply of different types of biomass (some have already been conducted by DNV KEMA) and characterization of biomass and process optimization in pilot plant facilities at ECN are important to support a smooth introduction of torrefied biomass in co-firing and also represent an important opportunity.

Finally, production of charcoal briquettes from sugar cane tops and green leaves is an opportunity at the medium scale, as it represents the need for an efficient charcoal production technology to generate additional revenue for Small Scale Growers.

83. http://www.engineeringnews.co.za/article/waste-and-residual-biomass-can-be-converted-into-energy-products-2013-05-03
84. Koppejan et al (2013)

3.4.5 Biomass combustion

IN SOUTH AFRICA THE FOLLOWING BIOMASS COMBUSTION APPLICATIONS ARE CURRENTLY IN USE:

- **Combined heat and power (CHP) using bagasse in the sugar industry. Traditionally the bagasse has always been burnt in energy inefficient boilers to provide the steam for the evaporative sugar crystallizers. In modern sugar mills co-generation technology is applied and surplus electricity is delivered to the national grid.[85]**
- **CHP using black liquor in the paper & pulp industry. Black liquor contains the non-fibre or lignin fraction of trees. After the pulping processes water is evaporated and the concentrated black liquor is used as fuel in a CHP station. With increasing plant efficiency modern paper mills are net suppliers of electricity to the national grid. The two main paper producers in South Africa are Sappi and Mondi, and both are already using this technology at several of their mills.[86,87]**
- **Efficient biomass cooking stoves for domestic use. Biomass combustion in efficient domestic cooking stoves is promoted by several organisations and programmes in Africa because they reduce the adverse health effects and environmental hazards of indoor pollution cause by traditional cooking on open fire. Although such programmes have been more successful in Eastern than in Southern Africa, with further increases in electricity prices, biomass is expected to once again become the fuel of choice of lower income groups in South Africa, opening up the market for efficient biomass stoves. The most popular such stoves are the Rocket-stove is promoted by Stichting Nederlandse Vrijwilligers (SNV)[88] and the gasifier stove developed by Phillips.**

THE MAIN TRENDS IN BIOMASS COMBUSTION IN SOUTH AFRICA FOR THE NEAR FUTURE ARE:

- **Co-firing of biomass in coal fired power stations for the national grid (see also section 4.4.4).**
- **Improve CHP efficiency by using high pressure biomass boilers.**
- **Increase the number of sugar mills producing electricity.**

COOPERATION OPPORTUNITIES FOR DUTCH TECHNOLOGY DEVELOPERS AND PROVIDERS ARE IDENTIFIED:

- **Determine fuel properties of South African types of biomass for the Phyllis data base for biomass and waste.[89]**
- **Optimize the co-firing conditions for biomass-coal mixtures in South Africa at Eskom's power stations.**
- **Innovate biomass high pressure boilers to increase efficiency and license this to hardware providers.**
- **Monitor the South African Sugar association (SASA) activities for tenders for co-generation at 14 sugar mills.[90]**

3.4.6 Biomass gasification

The gas from medium scale thermal biomass gasifiers is in most cases used in CHP units for off-grid power production and supply of process heat. A 2nd application is converting the syngas in transportation fuels, often considered as the main use of biomass gasification in rural areas.

While South Africa is well known for its synfuels produced by large scale coal gasification, the biomass application is hardly introduced in the country. Eskom and the University of Fort Hare recently installed a micro-scale biomass gasifier (300 Nm3/h, 0.15MW) that is used to power a bakery in the Melani village in the Eastern Cape province.

A new generation Fischer Tropsch technology has been developed by the former Centre of Materials and Process Synthesis (COMPS) at the University of Witwatersrand.[91] This medium scale technology is interesting for the local conversion of biomass into transport fuels, and could thus also be included in the section on biodiesel (as a main product of the FT process is biodiesel; however the FT reactor is fed by gassified biomass). Pilot plants are in operation in Australia (Linc Energy) and China (Golden Nest).

COOPERATION OPPORTUNITIES

Dutch providers of gasification plants in the range 10-20MW have ample opportunities in South Africa to start developing a market for the conversion of agricultural and forestry biomass into heat and power or transport fuels.

Introduction of biomass gasification in South Africa will require i) support by pilot tests in facilities available with Dutch technology developers on specific South African feedstocks, and ii) detailed design and costing of the final plant in cooperation between developer, provider and client.

3.4.7 Biomass pyrolysis

The pyrolysis process converts agricultural and forestry residues into marketable products with increased value as liquid fuels and chemicals, heat and power, and char as possible by product.

Biomass pyrolysis reactors are commercially available at medium scale: up to 50.000 ton biomass per annum corresponding with approximately 25MWth. At the moment the number of providers of complete pyrolysis plants is limited to four, located in the USA, Finland and the Netherlands. In South Africa, biomass pyrolysis is being researched at Stellenbosch University in cooperation with Sasol and at the University of Pretoria in cooperation with Sappi,

85. http://www.huletts.co.za/prod/co_gen.asp
86. Sappi, 2012
87. Mondi, 2012
88. http://www.snvworld.org/sites/www.snvworld.org/files/publications/improved_cookstoves_factsheet_lr.pdf
89. http://www.ecn.nl/phyllis2/
90. http://www.iol.co.za/news/south-africa/kwazulu-natal/farmer-to-set-up-green-power-1.1510983
91. COMPS has since ceased to exist, part of its staff and expertise is now with the MaPS centre at UNISA, see also Table 5.

TWO RELATIVELY NEW DEVELOPMENTS COULD POTENTIALLY BE VERY INTERESTING:

- **Pyrolysis of biomass fractions, e.g. lignin in the biorefinery or black liquor in the paper and pulp industry.**
- **The use of excess biochar that is not needed to heat the pyrolysis reactor as soil improver in biomass production or agriculture in general. However, the application of biochar in agriculture is still being researched.**

but no production sites for bio-oil are currently in operational in the country.

COOPERATION OPPORTUNITIES

Providers of pyrolysis plants in the range of 1-5 ton per hour have ample opportunities in South Africa to start developing a market for conversion of agricultural and forestry biomass into bio-oil and heat and power.

Introduction of pyrolysis in South Africa will require i) piloting and ii) detailed design and costing of the final plant in cooperation between developer, provider and client.

A 3rd opportunity in this subsector is a possible cooperation on the development of pyrolysis technology for biomass fractions such as lignin in the biorefinery or black liquor in the paper and pulp industry.

3.5 Summary of bioenergy opportunities

- **Fossil fuels versus sustainable renewable energy: In South Africa coal is abundantly available at low cost (± 25 USD/ton) which explains the current coal-based society. The main drivers to divert from coal are public awareness of GHG emissions, sustainability constraints by investors and regulations by the Government.**
- **Bioenergy versus other renewable energy technologies: from the point of view of government, biomass is a much more complex resource to manage compared to wind and solar, and requires significantly more regulation and value chain management compared to other renewables. At the same time, it also offers the most potential for rural upliftment and further development of the agricultural sector.**
- **Competing biomass applications: At the moment this is mainly about the on-going food-feed-fibre-fuel debate which in South Africa is intensified by the skewed wealth distribution and water scarcity. In the (near) future biomass will also be used for the production of chemicals to replace the current petrochemical industry which in South Africa is based on coal and crude oil.**
- **Different biomass conversion technologies. The selection of the best technology to convert biomass is determined mainly by the maturity of the technology, the availability and the type of biomass, the energy application, and the energy distribution method.**

TABLE 12: BIOENERGY OPPORTUNITIES FOR DUTCH TECHNOLOGY PROVIDERS IN SOUTH AFRICA

APPLICATION	IN SOUTH AFRICA		DUTCH TECHNOLOGY PROVIDERS	
	FEEDSTOCK	MAJOR PARTNERS	OPPORTUNITIES	RISKS
Biogas	Municipal sewage Industrial sewage Waste and process water Manure Plant waste Indigenous grasses Municipal solid waste	Animal farms SALGA Paper & pulp industry Food industry Dairy industry Abattoirs Agri SA Local biogas developers	• Pre-treatment of different types of waste. • Plant optimisation for different co-digestate combinations. • Recovering nutrients from digestate. • Realisation of complete farm level biogas installations.	As local manufacturing is at lower cost, the Dutch technology should be superior to be competitive.
Fuel Ethanol	Grain sorghum (now and mid-term) Agricultural and forestry residues (future)	Mabele Fuels Sugar industry Coega Industrial Development zone	• Fermentation reactor technology. • Energy efficient separation technology. • Enzymes for bioethanol production from lignocellulosic biomass.	No national blending policy for E-fuels (yet). Food versus fuel dilemma.
Biodiesel	Waste cooking oil (now), soybean and other seed crops (future).	Agri SA Coega Industrial Development zone Farming coops	• Lack of local expertise in industrial scale production of biodiesel from vegetable oil: opportunity to set industry standard.	No national blending standard for B-fuels (yet); Food versus fuel dilemma.
Torrefaction	Agricultural and forestry residues.	Eskom IPPs Sasol Sugar industry	• Pilot tests at 100 kg/h and plant design. • 50-100 kt/a torrefaction plants. • Pre-treatment for co-firing and for co-gasification. • Charcoal production.	International competition of technology providers Biomass availability on 100-200 kt/a scale.
Combustion	Agricultural and forestry residues.	Paper and pulp industry Sugar industry Eskom	• Determine fuel properties of new types of biomass for the Phyllis data. • Optimize the co-firing conditions for biomass coal mixtures. • Innovate biomass high pressure boilers to increase efficiency.	Expertise on commercial biomass combustion technology is limited in NL.

Gasification	**Agricultural and forestry residues.**	**Eskom IPPs Sugar industry Agri SA**	• **Pilot tests and plant design.** • **10-50 kt/a gasification equipment for off-grid electricity and process heat.** • **Gas purification units.**	**International competition (globally).**
Pyrolysis	**Agricultural and forestry residues.**	**Eskom IPPs Crude oil refineries Paper industry**	• **Pilot tests at 50 kg/h and plant design.** • **10-50 kt/a pyrolysis plants for off-grid electricity and process heat production.** • **Black liquor pyrolysis.**	**International competition (from the USA and Finland).**

An additional opportunity not necessarily related to a biomass production or conversion technology, but just as relevant for some sub-sectors, especially liquid biofuels for transport, is that of biomass logistics. In South Africa, there is limited experience with storing and transporting large amounts of biofuels, whereas the Port of Rotterdam and several companies operating within it, have already optimised biofuel distribution, which might be another promising area for cooperation.

4 SWOT ANALYSIS OF SUB-SECTORS IDENTIFIED AS MOST RELEVANT FOR DUTCH TECHNOLOGY PROVIDERS

4.1 All renewables

This section presents the summary of the most relevant information gathered for this study together with some additional insights in the developing renewable energy sector in South Africa, in the form of a concise SWOT analysis. The categorisation of factors as strengths, weaknesses, opportunities or threats depends to a large extent on the point of view taken. Factors that are not specific to the renewables sector in South Africa, but are inherent to the country's political and economic system and geography, are identify as the country's "internal" strengths or weaknesses. Conversely, "external" factors are those that create specific opportunities or pose threats to the development of renewables.

INTERNAL

STRENGTHS	WEAKNESSES
• Good to excellent resource base. • Developed infrastructure. • Relatively stable policy environment (low institutional risk). • Relatively business-friendly environment.	• Relatively cheaper and abundant availability of coal. • Economic and social system rely on centralised provision of energy services form conventional sources of energy. • General apathy and resistance to change.

EXTERNAL

OPPORTUNITIES	THREATS
• Effective government support scheme for several types of renewables. • Increasing interest from direct off-takers due to continuous price increases and insecurity of grid power supply. • Technical capacity building in term of: plant design, management, O&M, optimization and construction phase management. • Assistance in developing suitable sector standards and certification.	• Grid stress (limiting access to new generation capacity). • Municipalities often lack capacity to connect projects to the grid. • Lack of local capacity to solve technology to local conditions. • Slow progress in developing/ adapting necessary standards and lack of a local body to certify equipment, components and personnel to provide confidence to lenders and investors. • Lack of specialized, local skilled workers in the market, especially in remote areas. • Lack of O&M operators to satisfy lenders.

4.2 SWOT specific to bioenergy in South Africa

The bioenergy sector in South Africa is subject to most of the SWOT factors presented below, in addition to some sector-specific ones. These are summarised below:

INTERNAL

STRENGTHS	WEAKNESSES
• Significant waste biomass supply streams in some industries. • Significant job potential, especially in primary sector (agriculture and forestry, important for SA Government). • Cost reduction of bio-waste disposal.	• Financing vacuum for small projects & insufficient low-cost funding. • Biomass vs coal price: biomass still too expensive to represent a viable alternative to coal at 2-3 times the cost. • No formal, managed approach to optimal resource utilisation and allocation.

EXTERNAL

OPPORTUNITIES	THREATS

• Some large players considering significant investment into biomass (Eskom, Sasol, sugar industry).
• Some dedicated funding is available.
• Government is assessing the potential for bioenergy more seriously (recently commissioned a Bioenergy Atlas for SA).
• Substantial demand for co-generation of electricity and hot water.
• Importing biomass from neighbouring SADC countries that do not have water scarcity.
• Improved waste management requirements.
	• Government reservations on using food crops for energy purposes, resulting in
	  • insufficient government support
	  • weak government bioenergy strategy
	• Sectoral in-fighting limiting further developments.
	• Inefficient use of some biomass streams.
	• Water scarcity limits substantial increase in biomass production via agriculture and forestry in certain areas.

Key opportunities and threats are further elaborated with some concrete examples:

OPPORTUNITIES:

- **Eskom is considering co-firing up to 10% biomass in its coal power plants; this would require 12 – 14 mio dry tonnes/year of woody biomass (however, this is not an amount available locally).**
- **Sasol is also contemplating broadening its portfolio away from exclusively coal products.**
- **The sugar industry wants to generate its own energy supply and at the same time increase the value added of its residues (bagasse).**
- **Some funding is available: i.e. the IDC is supposed to finance a full-scale, first generation ethanol plant in the Eastern Cape (using sweet sorghum as feedstock). This project has been delayed several times due to bureaucratic systems. There have been some discussions about a demo plant of integrated 1st and 2nd generation ethanol processes that could be constructed next to the full-scale commercial plant, but this has not yet been realised.**
- **The recently commissioned Bioenergy Atlas for SA, which will provide a detailed overview of biomass potential in the country will make it easier to identify areas with suitable feedstock supply.**
- **Non-energy related legislation likely to provide a considerable push for some forms of bioenergy; the Waste Act likely to ban certain types of organic waste from landfills, providing significant opportunity for anaerobic digestion technology.**

THREATS:

- **Government reservations on using food crops (such as maize) for energy purposes, resulted in insufficient government support, which is focused more on other renewables and a weak government bioenergy strategy; non-conducive regulatory framework, stop-and-go policies**
- **Sectoral in-fighting: in the sugar industry there is a long-standing dispute between growers and millers, which is restricting efficient resource allocation.**

Based on all the above, some generalization notwithstanding, it is possible to conclude that the bioenergy sector in South Africa is in its early stages of development, where a lot of testing and learning still needs to take place, which means that new developments take a lot of time. But there is positive momentum for several bioenergy technologies, especially anaerobic digestion, torrefaction and gasification, and the lead times for certain processes are already shortening based on the early experiences of sector pioneers. The underdeveloped character of the sector also means there is no technological lock-in, leaving room for several technology options, although local adaptations will often be needed. However, this also offers opportunities for transfer of technical skills and local capacity building.
The socio-economic and business landscape of South Africa favours, indeed often demands, long-term presence and strong relationships with local stakeholders, which means South Africa should in most cases be seen as a long-term investment opportunity, either via local presence or a well-established local partner.

BIBLIOGRAPHY

Africa Business Group (2012): Southern Africa Clean Energy Assessment, USAID Southern Africa, Pretoria, Novemeber 2012

Bloomberg New Energy Finance . (September 2011). South Africa Decided to Give Wind and PV a Tender Embrace. Clean Energy Research Note .

Cardona, C.A., Sanchez, O.J. (2007). Ethanol production: Process design and integration opportunities, Bioresource Technology 98, pp. 2415-2457

DAFF (2012), Abstract of Agricultural Statistics, Department of Agriculture, Forestry and Fisheries of South Africa

Department of Energy . (2011). Integrated Resource Plan for Electricity 2010-2030. Retrieved August 2012, available on http://www.energy.gov.za/files/irp_frame.html

Department of Energy. (2011a). Request for Qualifications and Proposals for New Generation Capacity Under the IPP Procurement Programme; Volume 5: Economic Development Requirements. Department of Energy of the Republic of South Africa.

Department of Minerals and Energy, R. o. (2003). White Paper on Renewable Energy. Retrieved August 2012, available on http://unfccc.int/files/meetings/seminar/application/pdf/sem_sup1_south_africa.pdf

Department of Minerals and Energy. (2007, December). Biofuels Industrial Strategy of the Republic of South Africa. Retrieved February 2013, available on http://www.info.gov.za/view/DownloadFileAction?id=77830

Department of Trade and Industry. (2007). Broad-Based Black Economic Empowerment Act 53/2003): Codes of Good Practice on Black Economic Empowerment. Government Notice No. 112 . Pretoria: DTI.

DME (2003), South African Renewable Energy Resource Database, DME, Eskom, CSIR, Confidential report

DRD&LR (2011), Strategic plan 2011-2014, Department of Rural Development & Land Reform

E4Tech. (2009). internal analysis. Retrieved October 2012, from www.e4tech.com

IEA (2007), Peksa-Blanchard, M., Dolzan, P., Grassi, A., Heinimö, J., Junginger, M., Ranta, T., and Walter, A., Global Wood Pellets Markets and Industry: Policy Drivers, Market Status and Raw Material Potential, IEA Bioenergy Task 40

Index mundi (2013), available on http://www.indexmundi.com/energy.aspx?country=za&product=coal&graph=production

Koppejan, J., Sokhansanj, S., Mellin, S., Madrall, S. (2012). Status overview of torrefaction technologies. Final report.IEA Bioernergy Task 32

Korthuis, A. M. (August 2012). Climate Finance for Biomass - An inventory of climate finance options and a review of overlaps with biomass sustainability certification. Utrecht: NL Agency.

Krige, C. (2012, September). How to Play in a Competitive Environment; Presentation at Clean Power Africa Conference & Expo 2012. Retrieved March 20, 2013, from Kensani Capital: http:www.kensanicapital.co.za/wp-content/uploads/2012/10/CPA-PresentationCoenraadKrige.pdf

Kruger, L. (2011). The Impact of Black Economic Empowerment (BEE) on South African Businesses: Focusing on Ten Dimensions of Business Performance. Southern African Business Review, Volume 15 Number 3 , 207-233.

Mondi (2012): Mondi Sustainability Reports, available on http://sd-report.mondigroup.com/2012/downloads/MONDI-SSF12-ortgsi-05-energy-and-climate-change.pdf

National Treasury. (2010). Reducing Greenhouse Gas Emissions: The Carbon Tax Option, Discussion Paper for Public Comment. Retrieved September 2012, available on http://www.treasury.gov.za/public%20comments/Discussion%20Paper%20Carbon%20Taxes%2081210.pdf

Organisation for Economic Cooperation and Development. (March 2013). OECD Economic Surveys: South Africa 2013. OECD.

Sappi (2012): Southern Africa Sustainability Report, available on

Smith, A. (2013). Overview of Renewables and the Role of Methane. Methane Gas Power Projects in Africa 2013. Johannesburg: Aminergy.

Tiepelt, M. (2013). Biogas in South Africa. Methane Gas Power Projects in Africa 2013. Johannesburg: Aminergy.

Ward, M. (2012, June). Making Renewable Energy Affordable: The South African Renewables Initiative. Retrieved August 2012, available on http://cdkn.org/wp-content/uploads/2012/06/SARi-InsideStory_6pp_proof5.pdf

Zietsman, L. (2011), Observations on Environmental Change in South Africa. SUN Press, ISBN 978-1-920338-24-4


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