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**Bioenergy Project 2015/16**

**Synthesis Report**

  

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| Activities and insights for 2015/16March 2016  |
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For The GreenCape Sector Development Agency

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# Context, objectives and deliverables

## Background

Bioenergy is a cross-cutting focus area: agriculture and agri-processing provide key inputs to biofuels production, often in the form of wastes/residues or by-products; the production of bioenergy (specifically biofuel) and the processing of associated by-products are forms of agri-processing; and furthermore, biofuels provide direct energy, which can support economic activity and energy security in the Western Cape. Of note is that biofuels can provide different types of energy: gas, liquid fuels and solid fuels for cooking, heating, the generation of electricity (typically distributed, embedded generation) and transport.

## Goal and focus areas

The goal of the bioenergy project is to support the establishment of bioenergy infrastructure in the Western Cape and develop appropriate and sustainable supply chains that support agricultural productivity and rural job creation.

Based on insights from project activities since January 2014, three key focus areas were proposed for the bioenergy-related work in GreenCape in 2015/16:

* Exploitation of small-scale waste-to-energy opportunities for the production of bioethanol, biodiesel and biogas.
* Supporting the development of the triticale-based bioethanol industry, as highlighted from the previous work done through the GreenCape Biofuel Project (2014/15) and done in collaboration with Stellenbosch University, focusing on ready-to-market opportunities.
* Engagement with national departments, such as the Department of Energy (DoE), so that the national biofuel production strategies and implementation plans recognise the biofuel value chains suitable to the Western Cape.

## Deliverables

The following deliverables were identified in the project plan:

* Barriers for small-scale waste-to-energy projects unlocked
* Support to a high impact biofuel project through to development stage
* Progress on assessment of the viability of large scale bioethanol in the Western Cape in line with national biofuels strategies and implementation plans (among other through engagement with national departments and processes)

## Activities

The first two deliverables have been delivered primarily through sector desk activities which typically involve one-on-one meetings with companies and broader stakeholder activities (e.g. engagement in national platforms/working groups and industry events). These have been executed primarily by the Waste Sector Desk (biogas) and the Western Cape Industrial Symbiosis Programme (biogas, biodiesel, bioethanol), supported by Agriculture desk and Resource Productivity project.

The last deliverable has been done in collaboration with Stellenbosch University’s Department of Process Engineering which was commissioned to do a feasiblity study for large-scale triticale-based bioethanol as well as through engagement with the Department of Energy’s biofuels programme team and the primary potential project developer in the Western Cape.

## Progress on deliverables

## Small-scale waste-to-energy projects – unlocking barriers

The identification and unlocking of barriers to small-scale waste to energy projects is an ongoing activity as part of GreenCape’s sector desk (primarily Waste and Agriculture) and Western Cape Industrial Symbiosis Programme (WISP). The work in 2015/16 has allowed GreenCape to consolidate the understanding of these barriers and to play an active role in overcoming those linked to knowledge (of the technologies, their benefits, potential service providers, and regulatory requirements) through support to companies. (See the Bioenergy Quarterly Reports for a list of companies in small- to medium scale biodiesel, bioethanol and biogas assisted and the support provided.) However, the primary barriers are related to the regulatory environment (obtaining licences; feeding excess electricity onto grid to assist with project viability) and the availability of skills (especially for successful plant operation). These barriers are being addressed primarily through participation in and support to national initiatives including the GIZ SAGEN National Biogas Platform and UNIDO’s national biogas development initiative. GreenCape has provisionally signed up to the following national working groups under the auspices of the National Biogas Platform: finance, information, gathering, licencing, vehicular, fertiliser, rural and research. In Q1 of 2016/17, a decision will be made on potentially leading one or more of these national working groups. GreenCape expects to host one of the National Biogas Platform meetings in 2016/17. The US$ 4 million UNIDO national biogas development initiative will host a biogas technology forum (to focus on feedstock quantification and characterisation); technology demonstration (including support to install a total of 3MW capacity – at this stage none new in the Western Cape, but some support provided to an existing biogas project to enable the feeding of excess electricity to the grid); biogas market development (including assistance with quality standards, regulatory compliance and grid access) and the development of an investment strategy for biogas in South Africa. Due to the large degree of overlap between the work of the National Biogas Platform and the UNIDO national biogas development initiative as well as those of industry associations (primarily the South African Biogas Industry Association (SABIA) and the Red Meat Abattoir Association (RMAA)), a key role that GreenCape has been playing and will continue to play is connecting stakeholders so as to align efforts / obtain economies of scale and avoid duplication.

## Support to a high impact biofuel project through to development stage

GreenCape has provided ongoing and extensive support to a number of biogas projects (operational and under development). A summary of these has been included in the Q4 report on the project. The most significant of these (in terms of installed capacity and scale of investment) is the Bio2Watt / Cape Diary Biogas Project, Malmesbury, which is currently under development. A summary of the project and assistance provided is presented in the table below.

| Company | Bioenergy project | Stage of development  | Support provided by GC  | Status as at March 2016 |
| --- | --- | --- | --- | --- |
| **Bio2Watt/ Cape Dairy** | Biogas production at feedlots, 4 MW project, feedstock: primarily manure and straw bedding, but provision for a range of other organic feedstock; has bid under the small scale (1- 5 MW) REIPPP programme, decision expected in 2016. | Securing Environmental Impact Assessment (EIA) and feedstock | * Provision of suitable consultant list to undertake a feedstock analysis.
* Through WISP, sourcing of feedstock and identifying other potential feedstocks not previously considered.
* Through WISP, continual support in terms of feedstock identification and utilisation of the anaerobic digestion (AD) facility as an alternative to landfill.
 | EIA submitted for approval.Bio2Watt currently obtaining "in-principle" supply agreements from Malmesbury-based suppliers. |

## Viability of large scale bioethanol in the Western Cape

### Developing a Western Cape position for the national biofuels procurement programme

The study done by Stellenbosch Univerisity to determine the viability of triticale-based large-scale bioethanol production has been revised in the light of the substantial changes in the basic fuel price (BFP) over the last year. In addition, more detailed sensitivity analyses for model assumptions have been done.

* The work has been finalised by Stellenbosch University. An annotated summary presentation and all models have been provided to GreenCape.[[1]](#footnote-1)
* The annotated summary presentation will be used as foundation for a government briefing note for the Department of Energy (DoE) to be prepared by GreenCape in the first quarter of 2016/17. Input is required from DEDAT and the Department of Agriculture (DoA) to make the briefing note more suitable for distribution to national government (DoE). Specific input required from the DoA is evidence of the benefits of using triticale as a rotation crop (e.g. its ability to improve the productivity of margin land, potential opportunities for emerging farmers), as well as an updated estimate of the potential amount of triticale that can be produced annually to enable the scale of triticale-based ethanol production and the associated job creation potential in the Western Cape to be estimated more accurately.

DoE’s proposal for the regularory and subsidy framework was expected to go to Cabinet for approval in December 2015. It is expected that the French Development Agency (AFD) will then be tasked with designing a (pilot) competitive bidding program. Ongoing engagement with the Department of Energy (DoE) team responsible for the Biofuels Programme during Q4 revealed the following:

* The submission of the regulatory and subsidy framework as well as the piloting of a competitive bidding programme was indicated as being deliverables of the nine point workplan presented to the national Portfolio Committee on Energy by Minister Tina Joemat-Pettersson on 23 February 2016. The deadline for these deliverables 16 December 2016.
* However, the team responsible for the Biofuels programme at DoE incidate that they expect the process to be held up in Cabinet due to the pressures experienced by farmers as a result of the drought.

The biofuels programme thus appears to be stalled, but there is an express commitment to progress by the end of 2016. The biofuels team will thus finalise the briefing document with the view to submission by DEDAT to DoE in the first quarter of 2016/17 so as to provide a Western Cape perspective into the design of the competitive (pilot) bidding process.

### Support to potential investors

The annotated summary presentation prepared by Stellenbosch University has been sent to the principal potential large-scale bioethanol project developer in the Western Cape, namely Western Cape Ethanol (WCE). This presentation specifically includes recommendations for potential project developers.

Based on input from the DoE, WCE were advised earlier in the year to commence with the Environmental Impact Assessment (EIA) process and application for a biofuels licence in order to have approvals to operate in place to be able to participate in the competitive bidding process.

At this stage, the developer has put plans on hold due to the uncertainty surrounding the competitive bidding process, as well as potential challenges to source feedstock and investment capital.

Triticale is not currently being produced in the Western Cape in the amounts that could be required for large-scale bioethanol production. Stellenbosch University estimated a capital cost for a large scale (160 million litres per annum) using a conventional production process to be of the order of R 2.3 – 3.2 billion depending on the addition of a combined heat and power (CHP) unit. The internal rate of return did not exceed the 3.5% minimum to repay debts in the majority of scenarios examined and only exceeded 9.7 % (real basis) in a few extreme scenarios in the sensitivity analysis. It thus remains uncertain whether funding of this scale can be secured and hence whether there will be any bids for biofuels production from the Western Cape in the (pilot) competitive bidding process. The extent to which the Western Cape needs to proactively pursue this opportunity will be clarified as part of developing the briefing document which is to be finalised in Q1 of 2016/17.

# Key insights from 2015/16

## Small-scale waste-to-energy

* Small-scale projects in biodiesel and biomass continue to be the “quick wins” in the short-to-medium timeframe.
	+ - Small-scale biodiesel does not require a subsidy to be viable due to low capital requirements. However, the margins in this industry are under threat due to the low price of diesel. There is also some competition for feedstock since export of waste oil to Europe and the United Arab Emirates is increasingly favourable due to the weak exchange rate. The main support required by companies is accessing finance to increase their capacity mainly through diversifying their feedstock from waste oils to other materials such as animal fats.
		- The production of steam/heat (and not electricity) from biomass boilers is a niche opportunity with fewer legal requirements for project developers. However, there is a clear need for a comparative case for heat generation via solar energy versus using biomass, especially in the agri-processing sector.
* For small scale bioethanol there are a number of challenges:
	+ - Economies of scale: obtaining enough feedstock to make plants financially viable.
		- Cost of logistics: associated with the above; feedstock generally distributed so requires aggregation to obtain economies of scale; cost of transport makes aggregation beyond immediate surrounds too expensive.
		- Basic fuel price is low and no regulatory requirement at this stage for biofuels blending. (There is some premium for grape-based ethanol for the food value chain – represents higher value use of bioethanol than using bioethanol for fuel).
		- Alternative uses for feedstocks: many residues are already being used for higher value end uses (e.g. animal feed); there is some potential to extract energy *en route* to or to add value to animal feed (e.g. making residues more digestable). This requires a strategic anlysis to determine “best” use of different types of organic residues in the Western Cape economy, especially in the light of concerns about energy security and an impending biofuels blending programme.

For small- and medium-scale biogas the following key insights emerged:

* Biogas for public transport in the public sector in the Western Cape (or in the private sector via mini-bus taxis) is unlikely to occur in the short term. The realisation of the WCG and the City of Cape Town’s efforts to bring gas into the Western Cape either via pipeline or as compressed natural gas (LNG) and the associated establishment of LNG distribution infrastructure would be a more long term enabler for the biogas industry.
* Electricity, and secondly heat (through cogeneration), will remain the primary applications for the utilisation of the energy generation potential of biogas for commercial and industrial scale biogas.
* Key barriers to the uptake of biogas for electricity and heat are
	+ Type A: awareness of technologies; lack of knowledge of their costs & benefits; lack of confidence in unfamiliar technologies; perceptions of affordability/availability of finance;
	+ Type B: the time & cost associated with regulatory compliance; confusion regarding the regulatory framework due to the complex regulatory requirements and inconsistent application of these by regulating authorities.
* GreenCape’s sector desks plays an important role in addressing those barriers labelled as “Type A” above, and also play an active role in national initiatives addressing those barriers labelled as “Type B” (See the project quarterly reports for details of these activities and enabling role this plays for project developers and in national initiatives.)
* With regard to “Type B”, the WCG can play a signficant role through:
* Engagement with Eskom to accelerate the development of the framework for small scale embedded generation, as well as continued work on regulations and feed-in tarrifs in local municipalities (as is being done through the Energy Game Changer). Such regulations would allow projects with (an excess) generation capacity of less than 1 MW connected to low voltage grids (typical of potential agricultural and agri-processing biogas projects) to feed onto the grid, thus enabling revenue generation to support investment in biodigestors and electricity generation infrastructure.[[2]](#footnote-2)
* Efforts to create a processes for compliance with current regulatory requirements that is more transparent to the industry, and more efficient and consistently applied.[[3]](#footnote-3) (To assist in this, a summary of some of the key challenges for biogas project developers associated with regulations has been included in the Q4 report).

## Viability of large-scale bioethanol

The revised large-scale bioethanol viability study highlighted:

* + Feedstock price has a greater impact on the profitability of large scale bioethanol plants compared to the basic fuel price.
	+ Historical data shows that triticale (assumed to be equivalent to B4 Wheat) has been cheaper than sorghum (reference crop used by the DoE to determine the required subsidy model), which indicates that investment into a bioethanol facility in the Western Cape would yield better returns to the investor provided the biofuels subsidy programme does not restrict feedstock type.
		- This is a key area where the Western Cape needs to provide input to the national subsidy / competitive bidding process.
* Generating electricity on-site from a biomass boiler connected to a combined heat and power (CHP) would lead to the production of additional power that could be exported to the grid. This comes at a capital cost, but has the added advantage of an additional income stream as well as leading to a better carbon footprint for biofuels production. However the ability to generate income from this investment would be dependent on the ability to connect to the grid and sell the surplus electricity – this has proved a challenge for many renewable energy projects that have surplus power
* The impact of the different production processes (i.e. cold vs warm, and with/without pre-fractionation) were marginal on the overall internal rate of return (IRR). For that reason, a conventional bioethanol facility (i.e. warm and without pre-fractionation), which is a well-established technology, is likely to be the technology of choice for investors.
* A large uncertainty for investors in large scale bioethanol from triticale is linked to the fact that triticale is currently not being produced at large scale or traded on SAFEX[[4]](#footnote-4). Given the significance of feedstock price in determining financial viability setting, this suggests that long term contracts for feedstock or other means for benchmarking feedstock prices that provide price stability are important for financial viability.

The 15% return-on-assets (ROA) subsidy regime for the biofuels procurement programme proposed previously is likely to be replaced/augmented by some kind of price bid-in by potential producers. The bid-in approach is likely to aim to provide subsidy to projects that are most economically viable (e.g. have the highest internal rate of return (IRR)), in order to to minimise the required subsidy contribution per liter of ethanol supplied.

Key implications of the triticale-based large-scale bioethanol viability study for investors in ethanol plants are the following:

1. The business plan can be built on conventional warm process, without pre-fractionation. Differences in economic viability between alternative process configurations are not sufficient to overcome inherent business risks of grain costs and the basic fuel price (BFP).
2. Combined heat and power (CHP) plants with biomass as fuel source are recommended, especially if a secure offtake for excess electricity at an attractive rate can be negotiated with local municipalities (or Eskom).
3. Actively pursue opportunities to minimise grain and biomass input costs, through negotiations with local suppliers.
4. Be ready to bid-in at a competitive ethanol selling price, requiring the minimum subsidy support. Such a bid-in price will be dependent on financial measures (e.g. method of indexation; price caps) still to be defined by the national DoE
5. Participate in the anticipated request for information (RFI) from national DoE to demonstrate the potential and requirements of grain-ethanol in the Western Cape.

Key implications the triticale-based large-scale bioethanol viability study for the WCG, in particular DEDAT or DoA, are:

1. A subsidy scheme, or guaranteed higher sales prices than basic fuel price (BFP), will be required for grain-ethanol to be economically viable.
2. It would be necessary to actively lobby national government for a bid-in process that will allow participation of triticale grains in the Western Cape. Advantages of marginal drylands for grain production and potential for emerging farmers on these lands should be emphasised. The bid-in process, and specifically price indexation for the bid-in price, should not disadvantage Western Cape producers (e.g. indexation based on SAFEX sorghum, which is mismatched to price movements in Western Cape triticale could disadvantage Western Cape producers).
3. Development of emerging farmers utilising low-cost production methods for triticale grains from marginal lands should be prioritised: not only will bio-ethanol production require access to low cost feedstock, but regulations will also require a particular level of feedstock supply from emerging farmers.
4. Programs for clearing of invasive alien plants should be aligned to grain-ethanol projects to facilitate the supply of biomass as fuel for process energy generation to secure both economic and environmental benefits for biofuels.
5. Attractive feed-in tariffs from local municipalities can significantly enhance economic viability of bio-ethanol investments. Hence, the WCG should continue its efforts to enable municipalities to have regulations and feed-in tariffs to facilitate electricity sales from biofuels producers to local municipalities. This provides motivation for additional capital investments by project developers in combined heat and power (CHP) plants. When using biomass as fuel source, this enables the greenhouse gas (GHG) benefits of grain-ethanol production to be achieved and increases local renewable electricity production.

# Capacity and budget

## Capacity

As bioenergy is a cross-cutting focus area with links to several sector desks and projects at GreenCape, a management decision was made to deliver the project through the Waste Programme Manager (Gracia Munganga) and the Waste Sector Desk (Quinton Williams), in collaboration with the Resource Productivity Project (Cathy Pineo) and the Agriculture Sector Desk (Jannie Geyer and Inge Kuschke). However, Gracia Munganga left GreenCape at the end of September, so co-ordination of the bioenergy work in GreenCape was moved to the Resource Productivity Project (specifically Cathy Pineo) due to the strong link with agri-processing, which has been the focus area for the Resource Productivity project in 2015/16.

The specific opportunity areas have been driven as follows:

|  |  |  |
| --- | --- | --- |
| Name | Role in GreenCape and Project | Time period |
| Gracia Munganga | Waste Programme Manager : Project Manager | April 2015 – September 2015 |
| Cathy Pineo | Analyst Resource Productivity: Project Co-ordinator & Bioethanol | October 2015 – March 2016 |
| Quinton Williams  | Waste Sector Desk: Biogas and Bioethanol (industry & national engagement) | April 2015 – March 2016 |
| Usisipho Gogela | Bioenergy Intern: Biogas | March 2016 |
| Inge Kuschke | Agricultural Sector Desk Analyst: Bioethanol | April 2015 – March 2016 |
| Jannie Geyer  | Agricultural Sector Desk Analyst: Biogas | April 2015 – February 2016 |
| Jarrod Lyons | Western Cape Industrial Symbiosis Programme Facilitator: Biomass, Biogas and Biodiesel | April 2015 – March 2016 |
| Emmanuel Kasese | Western Cape Industrial Symbiosis Programme Facilitator: Biodiesel | April 2015 – February 2016 |
| Lauren Basson | Manager: Techical and Knowledge: Technical Support | April 2015 – February 2016 |

This extensive staffing on bioenergy across a number of programmes in GreenCape is consistent with the cross-cutting nature of bioenergy. By spreading the responsibility across these programmes, there is potential to draw from the extended expertise and networks across the organisation and support the development of bioenergy. That said, the reprovision of full time capacity in this space will be considered as part of the business plan going forward, in response to the scale of the opportunity which has been estimated (and continues to be reviewed) as part of GreenCape’s market intelligence and strategy processes. Dedicated capacity is expected to put GreenCape in a stronger postion to play a more active role in the development of the bioenergy industry in the Western Cape, especially in small-scale waste-to-energy, particularly biogas, which appears to be at the cusp of a step-change in uptake. A bioenergy intern was appointed in March 2016 to review the scale of the opportunity for biogas and examine the business case for biogas in animal husbandy (diaries, piggeries, poultry, abattoirs) primarily via case studies of existing and stalled biogas projects

## Budget

The project budget for 2015/2016 was R 850 000 provided by the Department of Economic Development and Tourism.

1. GreenCape will also receive a copy of the final post-examination disseration by the engineering masters student who was the primary researcher on the project. This is expected by the second quarter of 2016/17. [↑](#footnote-ref-1)
2. The role of biogas with storage as potential peak generation capacity is of particular significance in making the case for biogas as smaller scale embedded generation capacity. [↑](#footnote-ref-2)
3. The efforts of industry associations (e.g. the South African Biogas Industry Association (SABIA) and the Red Meat Abattoir Association (RMAA)) to support improvement in the regulatory framework and streamline the regulatory processes (e.g. through the development of Norms and Standards) is aimed at resolving these challenges. However, this may only impact in the medium term (3-5 years), so the recommendations made here are aimed at enabling the WCG to provide shorter term enablers. [↑](#footnote-ref-3)
4. South African Futures Exchange [↑](#footnote-ref-4)