



Bioenergy and Product Diversification Project

Output Deliverable 2: Final Report

incorporating recommended changes from the Steering Committee
provided at the final Steering Committee Meeting held on 23 February 2017

Note: This report (and the accompanying appendices) contains company-confidential information. As such, it is not to be distributed without permission from GreenCape and the companies involved.

March 2017

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Executive Summary

Background

This report presents the second and final output deliverable for the Bioenergy and Resource Productivity Project. The project was commissioned by the Green Programmes and Projects Unit of the Department of Economic Development and Tourism (DED&T) of the Western Cape Government (WCG). The project ran over a period of three and a half months (17 November 2016 - 28 February 2017).

Project Objectives

The project had the following objectives:

- **Objective 1:** To identify opportunities for value-add to organic waste/residues in food value chains that would provide the greatest economic benefit to the Western Cape.
- **Objective 2:** To drive uptake of renewable energy technologies in agri-processing (specifically solar PV systems for packhouses and solar thermal applications within the industry), as well as resource efficiency within the food value chain (specifically through the diversion of organic waste from landfill to value-add applications such as animal feed).

Linked to the above objectives, the following were the output deliverables:

- **Deliverable 1:** A strategic scoping study on value-add opportunities for organic waste/residues in food value chains with the view to identifying at least two opportunities for further development (e.g. through business cases) and general recommendations for enabling actions by the WCG for the uptake of value-add opportunities.
- **Deliverable 2:** Progress in the uptake of the selected green technologies through executing the enabling actions assigned to GreenCape in the implementation plans (“landing plans”) submitted DED&T in 2015/16
- **Deliverable 3:** Dissemination of project findings via a workshop with relevant stakeholders and the development and distribution of communication materials to relevant stakeholders.

Based on the recommendations of the Steering Committee, the last of these deliverables was replaced with a second Steering Committee meeting during the project period (held on 23 February 2017) and targeted dissemination to key stakeholders after project completion (to create more time for delivery and feedback within the short project timeframe, and to drive greater impact by direct communication of specific messages to key stakeholders that are able to act on the findings and recommendations of the work, respectively).

Deliverable 1: A strategic scoping study on value-add opportunities for organic waste/residues in food value chains

The goal of the study was:

- to do a high-level review of the organic residues and wastes arising from food value chains to identify those value chains that show the greatest potential for value-add in the short to medium term (3 – 5 years).
- to identifying at least two opportunities for further development, and
- to develop general recommendations for enabling actions by the WCG for the uptake of value-add opportunities.

Approach

The scoping study was done in two phases.

In the first phase of the project, the following was completed:

- A quantitative analysis of residues to determine the amounts potentially available in the food value chain, drawing on data from the latest Agricultural Census (2007) and literature-based residue-to-product ratios.
- A qualitative analysis of the potential for value-add based on a value-add hierarchy i.e. power & heat (level 5); fuel (level 4); materials & chemicals (level 3); food & feed (level 2); fine chemicals & pharmaceuticals (level 1).

The qualitative and quantitative assessments were then analysed to identify those value chains with highest potential, i.e. in terms of quantity and in terms of value-add potential. Two additional criteria were added, namely evidence of availability, and drivers / incentives. This produced an initial shortlist of value chains for further consideration in the second phase of the work. The following value chains were selected for further consideration:

- Cereals up to bakery products
- Vegetables and fruit (grapes, citrus and other fruits)
- Red meat value chains up to abattoirs
- Poultry value chains
- Dairy value chains.

During the second phase of the study, the value-add potential in the target value chains and expected impact were evaluated according the following criteria: product value, cost savings, job creation, landfill diversion, and time scale for realisation. Collectively these can be considered to cover 'financial viability' or 'likelihood of being implemented'.

Evaluation of the first four criteria was done via a quantitative assessment using information available from a variety of sources.

- The time scale for realisation was determined from qualitative information gathered from industry associations and selected companies in the target value chains.
- Where there was a willingness to share this, quantitative information (e.g. amounts of residues generated, financial information) was also gathered from the interviewees.

Residues could potentially go to a multitude of value-add end-products. To make the analysis of potential impact of realising the value-add opportunities tractable within the time available, a number of defined value-add endpoints in the value-add hierarchy common to the target value chains were selected to allow comparison between opportunities in these value chains. The production of biogas for energy (level 4 and 5 in the value-add hierarchy), as well as composting (level 3 in the value-add hierarchy) and (the production of) animal feed (level 2 in the value-add hierarchy) were selected as end-points. A range of estimates for potential impact was generated:

- The bottom end of the range was based on data gathered from stakeholders during interviews (the "sample" set). It was assumed that residues and wastes could be directed to any higher level value-add uses, but not to any lower value-add uses.
- For the top end of the range ("residue estimates"), an attempt was made to make a more absolute comparison between the value-add potential. Assumptions were made that particular portions of the amount of residues / wastes were available as determined through sector expert engagement.

Results

For the value chains examined the findings were summarised in tables capturing:

- availability / current use, drivers, barriers and business case/appetite for alternatives (from the qualitative analysis), and
- the landfill diversion potential and economic benefits in terms potential investment, potential sales and potential job creation for the four value-add endpoints i.e. biogas, composting, animal feed and enhanced animal feed/insect protein (quantitative analysis).

Note that no information could be obtained for the poultry value chain which is under severe pressure and is considered to be unlikely to consider changes to value chain practice. The poultry value chain was thus eliminated from further consideration.

Findings from the qualitative analysis

Based on the qualitative analysis the following can be concluded:

- Residues and wastes are generated, but the majority is not available due to being diverted to alternative uses, mostly animal feed. South Africa appears to have very good cascading of organic materials between different end-uses. Based on availability of waste, potential business case and appetite for alternative waste management, the potentially highest impact opportunities appear to be in: Fruit and vegetable value chains and Abattoirs
- For fruits and vegetables, there appears to be particular potential at the value chain level, at packhouse/distribution centres and retailers in urban areas. At the commodity level, there is potential for lower grade potatoes and potato residues, especially in the Sandveld region. At the retailer end, there appears to be substantial interest in waste-to-energy as this is anticipated to return benefits, but this may be due to lack of awareness of alternative value add options and consideration of the relative merits of business cases for all available value-add alternatives.
- For abattoirs, composting appears to be the preferred value-add technology, primarily due to: cost, ease of operation and ability to sell the compost product. Other value-add options such as biogas and rendering are often considered, but a range of concerns (cost, operability, stakeholder perception, product market) are making uptake more limited.

Findings from the quantitative analysis

From the quantitative analysis the following it can be observed:

- In terms of unutilised waste (potential for landfill diversion) in the sample set (lower bound), the dairy and abattoir sectors are largest, followed by fruit, and to a lesser extent, vegetables and bakery waste. In terms of potentially unutilised waste (i.e. the upper bound estimate), the total volumes for fruit and vegetables are greatest and similar to that for abattoirs.
- This trend is broadly similar when assessing the economic benefits for the sample set, although:
 - Abattoir waste has particularly significant benefits, including job creation, when diverted to biogas. These benefits are approximately double those obtained using dairy waste.
 - Abattoir and dairy waste have similar economic benefits for composting, exceeding those estimated for vegetables, fruit and bakery waste.
 - Fruit and vegetables perform well in terms of high value utilisation for animal feed.
 - Dairy and abattoir waste are associated with significant benefits, including jobs, when upgraded to animal feed through insect production. However, the benefits were also relatively significant for fruit, vegetables and bakery waste.
- In general, for both the sample set and residue estimates, the economic benefits align with the value-add hierarchy, where greater economic benefits are generally seen for animal feed (particularly upgraded animal feed through insect production) than for composting and biogas.
- When looking at the potential economic benefits for the upper bound estimates, it is clear that upgrading organic residues to animal feed through insect production provides the greatest economic benefits, particularly for abattoir wastes. The opportunities for the fruit and vegetables taken together are similar to that for abattoirs, but abattoir waste remain the stream with the largest expected economic benefits through value add.

Further insights and observations

More generally from all the analysis work, the following observations can be made:

- Water/effluent management and carbon emissions appear to be greater concerns for larger companies. For these companies, the case for value-add must thus have benefits in terms of reduced water use, reduced carbon intensity and improvement in profitability. Additionally, there has been a retailer and importer shift to sourcing products from suppliers that are more environmentally responsible.
- Of the waste streams identified during industry interviews, less than 2.5% of residues and wastes (by mass) did not already have a use. This is clear evidence of residues and wastes being cascaded within South Africa.
- A significant share of wastes ($\pm 20\%$) is already going to a relatively high value use in the form of animal feed. This may be in part due to animal feed often being silaged and thus better able to deal with seasonality. However, animal feed may act as a 'cheap disposal' method or grain-feed substitute and may not necessarily be "high value". The wide applicability of insect protein production as animal feed as a value-add opportunity makes this a significant opportunity, especially when considering that the wastes going to animal feed could be upgraded through this mechanism.
- The general value-add hierarchy, obtained from a Dutch study tour and used as a heuristic guide in this analysis, appears to broadly align with the local Western Cape context. However, it is clear that the quality of animal feed needs to be taken into consideration and that this will be complex with respect to value-add. As a result, feed is not necessarily by default a high-value application (in the Western Cape at least, where sending organic residues and wastes to animal feed may in fact be a cheap disposal strategy) and animal feed could fall within a lower tier depending on a broad range of factors.
- At the start of the study period, approximately 30% of abattoir wastes in the sample set were unused. However, within a few months, these are now being utilised, primarily for composting, driven in part by legislative pressure and GreenCape's assistance.
- (Lack of) economies of scale remain a key constraint, especially for the uptake of biogas, as agricultural residues have strong seasonality and are typically dispersed. Opportunities may be unlocked by aggregating smaller waste streams, however the cost of logistics remains a barrier.

Selection of two opportunities for further development

Drawing together the findings from the qualitative and quantitative evaluations, it can be concluded that the uptake of value-add technologies in the following value chains would deliver the greatest economic benefits (investment, sales and job creation) and expected landfill diversion in the Western Cape in the short to medium term (3-5 years):

- Fruit and vegetable value chains, with indications that there is potential for greater value add and resultant economic benefits in vegetable value chains, particularly potatoes.
- Red meat value chains, with a particular focus on abattoir wastes.

It is recommended that these value chains be examined further to identify exact intervention points in the value chains and mechanisms to enable the economic benefits of the value-add opportunities to be realised.

General recommendations for enabling actions by the WCG for the uptake of value-add opportunities

There are several specific recommendations for enabling actions for DED&T for the uptake of value-add opportunities, as well as general recommendations for the WCG. These are provided in detail within the report. Key recommendations are that:

- Department of Environmental Affairs and Development Planning (DEADP), supported by DED&T, improve access to high quality organic waste, particularly in the household and commercial sectors in urban areas. This can be done, in part, by:
 - Driving waste minimisation to and/or diversion from landfill, with DED&T playing a role in assessing the level of preparedness of the industry and the potential economic impact
 - Supporting efforts within the public and private sector for the source separation of organics from other waste, specifically:
 - Supporting City of Cape Town (CoCT) and other municipalities in alternative waste management efforts.
 - Supporting DEADP and GreenCape’s efforts to encourage municipalities to use decision support tools for integrated waste management planning through improved capacity and funding.
 - Continue to fund and support GreenCape’s Western Cape Industrial Symbiosis Programme (WISP) and the Waste Sector Desk.
 - Supporting the strategic availability of a centralised depackaging facility.

- DEADP, supported by DED&T, create an enabling environment to encourage value-add to organic wastes. This includes:
 - Supporting DEADP to develop clearer regulations and more efficient compliance processes for activities that enable value-add to organic wastes, with DED&T specifically focused on identifying enabling / support mechanisms for alternative value-add solutions.
 - Supporting DEADP to enable the more rapid development of municipal by-laws aimed at diversion of organic waste from landfill.

- DED&T and DoA recognise the value of the secondary (and often informal) markets and systems that play an important role in value retention and extraction, particularly fruit and vegetables. Specifically, it is recommended that these departments:
 - support these markets by lending support in terms of improved logistics (e.g. collection points for aggregation of produce, waste collection), and
 - establish refrigerated/cold storage facilities to retain value and reduce waste.

- DED&T and particularly the DoA evaluate knock-on impacts from the diversion of organic residues from current applications where residues are used for animal feed. This includes:
 - Consideration of the ecological impacts of diversion of residues and policy misalignment or conflict (e.g. with respect to conservation agriculture).
 - Support R&D initiatives that upgrade animal feed in a manner that supports local economic development and safeguards the economic viability of farmers.

- DED&T, supported by DEADP, DoA and the Department of Trade and Industry (dti), address the lack of confidence in and awareness of the full range of value-add technologies and their business and economic impacts, with a specific focus on:
 - driving awareness of alternative energy (including bioenergy) and value-add options, and
 - assisting businesses and policy makers to understand the implications of this technology both at a micro and macroeconomic level.

- DED&T, DEADP & DoA support localised commodity-specific value-add opportunities, specifically:
 - Value-add to potato waste for starch production for food/feed or compost.
 - It is recommended that DED&T and DoA support the industry to examine the business case for value-add, including the economies of scale required to make the collection and processing of potatoes for food-based products or feed feasible, and assess its potential benefits for farmers.
 - Value-add alternatives for red meat abattoir waste.

- There is a clear need to assess the business case and wider benefit for value-add alternatives for abattoir waste (specifically composting, biogas and rendering) to enable the greater local and provincial economic benefit to be realised. Specifically, it is recommended that DED&T:
 - Fund the development of information and tools for the range of value-add alternatives for abattoir waste.
 - Identify (and if necessary support the development of) provincial and national supporting mechanisms (e.g. grants, incentives) to assist abattoirs to investigate and ultimately invest in alternative value-add technologies.
 - Continue to fund GreenCape’s clustering programme (including the Waste, Bioenergy and Agriculture Sector Desks) to extend the level of industry support to abattoirs as well as to the providers of a range of value-add technologies.
- DED&T continues to fund activities that support value-add to organics (with demonstrable record of impact) and enable businesses to benefit from the international expertise and business partnerships.
 - This includes support for GreenCape’s Bioeconomy Programme (Resource Productivity Project, Bioenergy Sector Desk, Agriculture Sector Desk), WISP and Waste Sector Desk, as well as the highly successful Cross-Border Business Matchmaking Programme hosted by GreenCape.

Deliverable 2: Progress in the uptake of the selected green technologies

The Resource Productivity Project, commissioned earlier by the Department of Economic Development and Tourism (DED&T), identified three green technologies that could make a significant impact in terms of reducing the carbon intensity of food value chains, and specifically at the agri-processing stage. Business cases and implementation plans (“landing plans”) were developed for these green technologies in 2015/16.

As part of the current three-month Bioenergy and Product Diversification Project, the goal was to drive uptake of these renewable energy technologies, namely solar PV systems for packhouses and industrial scale solar thermal systems, as well value-add to resource efficiency within the food value chain through the diversion of organic waste from landfill to production of insect protein for animal feed.

The uptake of these technologies was promoted by executing the enabling actions assigned to GreenCape in the implementation plans (“landing plans”) for each of these opportunities. The baseline of uptake to date was developed and a range of actions undertaken to meet the DED&T target of progress in the uptake of the technologies by 2-5 companies.

All targets were met as shown in the table below. The table also includes insights gained from undertaking the activities to meet the targets and some additional achievements in relation to the uptake of each of the three technologies.

Baseline and uptake of green technologies in 2-5 business for the three selected green technologies

Technology	Baseline	Progress	Insights and achievements
Insect protein	<ul style="list-style-type: none"> • 5 200 – 10 400 tonnes per annum 	3 synergies between companies realised with a total of 850 tonnes diverted per annum	<ul style="list-style-type: none"> • Potential solutions providers for C40 City Solutions Platform (CSP) • GreenCape & Innovation Norway connected AgriProtein to the Heidner Cluster providing Agriprotein an opportunity to enter the Norwegian market & become involved in joint research projects

Solar PV	<ul style="list-style-type: none"> • 10.2 GWh per annum of electricity generated by in wineries and packhouses • 14.62 GWh per annum in agriculture in the WC 	<p>4 companies supported:</p> <ul style="list-style-type: none"> • 2 in food & beverages • 1 textile company • 1 farm. 	<ul style="list-style-type: none"> • Generally, this is a well understood opportunity with uptakers looking for acceptable payback periods • Interest from potential uptakers primarily in available financing opportunities • The ESCo model needs to be better communicated as companies consider capital cost a key constraint (payback periods), but are not taking up ESCo models that remove or decrease the capital cost • Uptakers are also wary of ESCo model where they are reliant on a solar PV system on their premises that they do not own
Solar thermal	<ul style="list-style-type: none"> • 13.9 GWh of heat energy being utilised per annum (conservative estimate) 	<p>4 companies supported:</p> <ul style="list-style-type: none"> • 1 in food & beverages • 2 textile companies • 1 construction 	<ul style="list-style-type: none"> • Solar thermal is a more complex solution than PV, but the complexity is offset by higher efficiency ($\pm 40 - 60\%$) when compared to solar PV ($\pm 20\%$) • Industry is relatively unaware of the solar thermal opportunity with local case studies key in unlocking additional uptake

Outlook

This project has reinforced that the Western Cape is already very good at cascading organic residues in the food value chain from high to lower value applications, but that there are still substantial economic (and environmental) gains available from diverting organic residues and wastes away from landfill to a range of value-add applications. For readily implementable value-add technologies, estimates suggest that these benefits could be in the order of R 52 million to 4 billion in investment and 30 to 1100 direct jobs depending on the technologies applied. The report has also identified clear actions that the WCG, and specifically DED&T, DEADP and DoA, can undertake individually and collectively to enable this potential to be realised to the benefit Western Cape economy in the short to medium term and ultimately enhance its competitiveness and resilience.

Acknowledgements

Project funding:

The Bioenergy and Product Diversification project has been funded by the Western Cape Department of Economic Development and Tourism (DED&T).

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The guidance of the steering committee is acknowledged with appreciation.

A list of the steering committee members is provided below.

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* Not in attendance at Steering Committee Meeting 1 on 24 November 2016

Not in attendance at Steering Committee Meeting 2 on 23 February 2017

Other input and support

A large number of organisations have contributed to the project by sharing information either through interviews, workshops or sharing of documents.

For the scoping study component:

The companies contacted for the interviews are not listed here to protect company confidential information. However, the willingness of the company staff to be interviewed and to share knowledge and data is much appreciated.

For the uptake of green technologies component:

We would particularly like to thank the following:

- Insect protein: Jason Drew, Wilco Drew, Cobus Kotze and Liesel Olivier from AgriProtein Technologies
- Solar thermal: Louise Scholtz of WWF and Ulrich Terblanche and Stefan Hess from the Solar Thermal Energy Research Group (STERG) of the Centre for Sustainable and Renewable Energy Systems (CRSES) at the University of Stellenbosch and Werner Weiss of AEE INTEC.
- Rooftop PV: Koos Bouwer of Koos Bouwer Consulting

The time and effort to assist the project team is greatly appreciated.