Resource Productivity Project 2015/16

Improving resource productivity in Western Cape agri-processing

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Executive Summary

1.1. Introduction

In the Western Cape (and more widely in South Africa) the availability, quality and increasing cost of resources (e.g. water, energy and raw materials) may limit aspirations for economic growth and job creation. Improving resource productivity, or doing more with less, is thus seen as critical - both for safeguarding existing businesses and for developing the Western Cape economy.

For local businesses, more effective use of resources has several benefits such as cost savings, improved competitiveness and enabling potential investment to expand or diversify, thereby fuelling economic growth. For the economy, improving resource productivity enables the decoupling of resource use from growth, which is critical for sustainable economic development.

1.2. Resource Productivity Project

The Resource Productivity (RP) project aims to unlock the potential of the Western Cape's bio-based resources and drive the "greening" of agricultural value chains through promoting the uptake of investment in green technology, processes and systems. The RP project followed the 2013-15 Regional Resource Flow Model (RRFM) project and builds on key insights related to the resource efficiency of key sectors within the Western Cape economy[1].

In brief, the RRFM project's macro-economic analysis highlighted the food and beverages value chain as a key area for greater resource efficiency (2013-14). The carbon intensity of agriculture was thus further examined (2014-15), with a specific focus on five key sub-sectors, namely: grain, wine grapes, other fruit and livestock (including game).

The RP project was then initiated in 2015 and continues to focus on identifying the opportunities for and barriers to resource productivity, with a specific focus on agri-processing in 2015/16. Two strategies were applied in terms of driving resource productivity: improving resource efficiency (e.g. using less land, energy, water or materials to produce the same outputs), and/or value-add or waste beneficiation (e.g. recycling or producing new products from wastes).

1.2.1. The Bioeconomy Programme

The RP project is situated within GreenCape's Bioeconomy Programme (see Figure 1 overleaf) and works closely with the Bioenergy Project and the Sector Desks, particularly the Agriculture Sector Desk. In conjunction with the Bioenergy project, the RP project provides a strategic analysis of opportunities and barriers along key value chains. The dissemination of insights and implementation of recommendation is then primarily driven in conjunction with GreenCape's industry-facing Sector Desks and the Western Cape Industrial Symbiosis Programme (WISP). For more information visit the GreenCape website[2].

[1] For more detail see the RRFM Project 2014/15 Synthesis Report.

[2] Information on GreenCape Sector Desks and projects is available on the website (www.greencape.co.za)

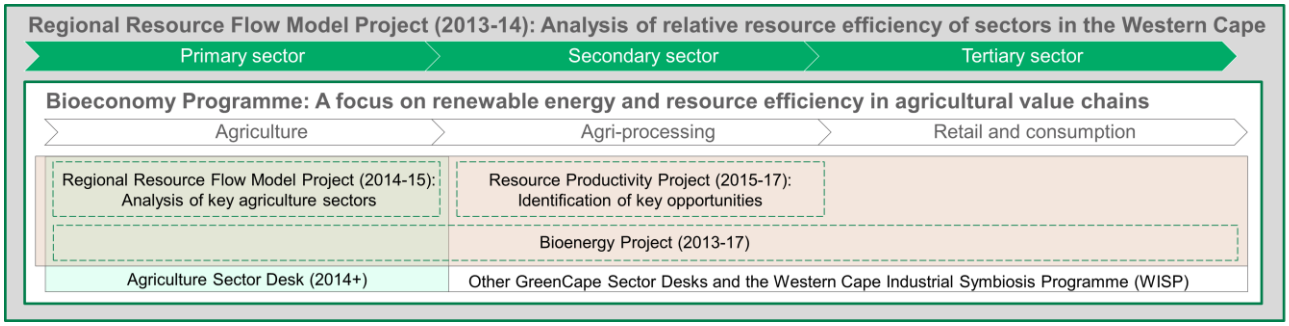

Figure 1: GreenCape's Bioeconomy Programme

1.3. Project objectives

The RP project had three objectives:

- To identify the resource-based challenges and economically viable opportunities for resource efficiency and value-add within key agri-processing sub-sectors, including exploring waste beneficiation within a specific sub-sector with high potential.
- To unlock the key opportunities for resource efficiency in collaboration with GreenCape's sector desks, specifically those that enhance productivity and competitiveness.
- To disseminate information on these opportunities, their benefits and enablers to key stakeholders who can influence or effect their realisation including Western Cape Government (WCG), specifically the Department of Economic Development and Tourism (DEDAT) and Department of Agriculture (DoA), as well as industry associations and companies.

1.4. Project approach

A screening process was used to identify the key resource productivity opportunities within agri-processing. The process included:

- **Stakeholder engagement** to assess the resource-based challenges and opportunities for key agri-processing sectors, specifically interviews with relevant industry associations and key companies.
  - Key insights were summarised as SWOT analyses[3].
- **Prioritising opportunities** based on the size of the opportunity and ease of influence (i.e. whether they align with the mandate and key implementation support capabilities of GreenCape).
  - Key opportunities for agri-processing were identified to be *renewable energy* (specifically solar) and *value-add to waste*.
- **Prioritising a key sector** to drive the uptake of green technology.
  - The *fruit sector* was selected as a specific focus area based on its economic significance.
  - The analysis of the fruit sector and the process of prioritising opportunities for value-add are discussed in further detail below (Section 1.4.2 and 1.4.3 respectively).
- **Selection of business cases** to demonstrate or assess green technology opportunities, as well as actively driving the uptake of relevant opportunities within the sector.
  - Three *business cases* were developed in line with the prioritised focus areas.
  - These are described in greater detail in Section 1.5.

[3] SWOT: Strength, Weaknesses, Opportunities, Threats

1.4.1. A focus on the fruit industry

The RP project focused on fruit value chains due to the fruit sector's high labour absorption (particularly for unskilled labour), significant contribution to economy (>R8 billion) and significant exports (±80% of products exported).

As part of the prioritisation of the fruit sector, the project developed an understanding of fruit volumes and values for different agri-processing industries, specifically fresh fruit (which can be stored and packaged for local consumption or export) and processed fruit (including canned fruit, dried fruit and fruit juice).

This is summarised in **Error! Reference source not found.**. The diagram indicates the volume flows within the fruit sector (in green) and the value of the different industries (in orange), with the width of the arrow indicative of the size of the contribution.

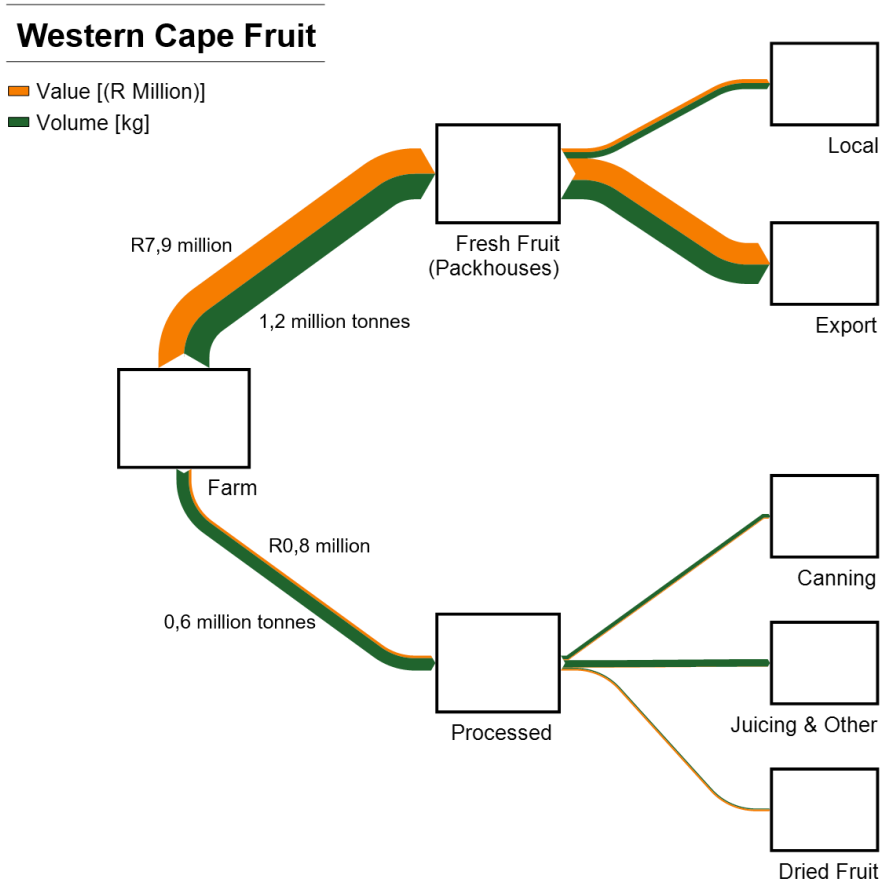

Figure 2: Mass and value flows for the fruit industry in the Western Cape

1.4.2. Prioritisation of value-add opportunities

The project considers agricultural value chains in an integrated manner and prioritises opportunities for full value extraction through the use of the value-add hierarchy (see Figure 3 overleaf).

As shown in Figure 3, bio-based residues can be utilised for energy applications; however, there are many higher value opportunities that should be prioritised and thus only the lowest quality residues should be utilised for power and heat. As solutions become entrenched over time, the current energy crisis presents an interesting challenge; short-term concerns regarding energy security energy could skew the utilisation of residues towards energy applications. It is thus essential to ensure that value-add opportunities (and their benefits to the economy as a whole) are not lost due to an increased focus on waste-to-energy application, particularly when other renewable energy opportunities are so promising in South Africa (specifically solar energy).

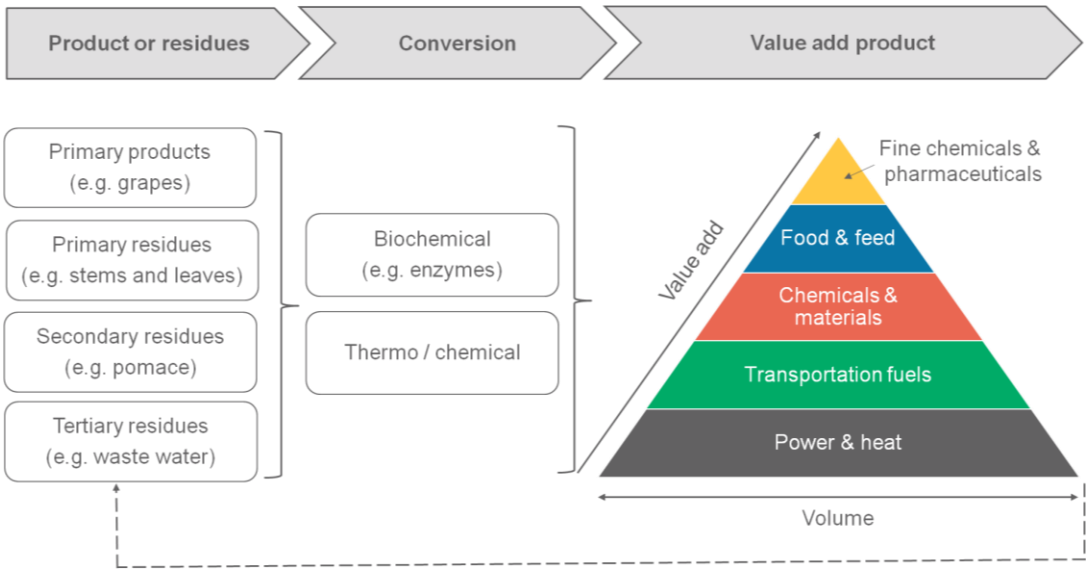

Figure 3: Value-add hierarchy for bio-based residues (adapted from the Bioeconomy Study Tour, Netherlands Department of Foreign Affairs, 2015).

1.5. Project deliverables and outputs

There are two sets of deliverables derived from the identification of high-impact green technology opportunities within agri-processing. The first set was delivered in the form of three business cases which are publically available from GreenCape as stand-alone reports. These comprised of two business cases focussed on solar energy applications within agri-processing and one business case focused on high value-add to organic waste.

These business cases are:

- Solar photovoltaics (PV) for packhouses
- Solar thermal for industrial-scale heating in agri-processing
- Bioconversion of organic waste into high-value insect protein for animal feeds

The second set of deliverables was focused on driving and implementing potential opportunities within the agri-processing industry, in collaboration with the GreenCape Sector Desks and projects.

These opportunities include:

- Providing assistance to large agri-processing companies to identify and drive improved resource efficiency and value-add, specifically within the fruit canning industry.
- Development of solar drying technology through collaborative partnerships, particularly for the dried fruit industry.
- Unlocking the biogas potential in agriculture and agri-processing, in part through examining the opportunity for use of biogas as a transport fuel.

The schematic flow diagram for the fruit sector shown in Figure 4 overleaf provides a summary of the RP project's outputs. The business cases (numbered squares) and the three key opportunities prioritised for green technology and resource productivity projects (numbered circles) are mapped onto the diagram. These opportunities have been labelled to correspond with the value-add hierarchy (see colour key) and indicate that the project both examined alternative energy opportunities (primarily driven by interest from industry), and value-add opportunities for fruit organic waste (in line with a more strategic focus on the best use of resources in the Western Cape economy).

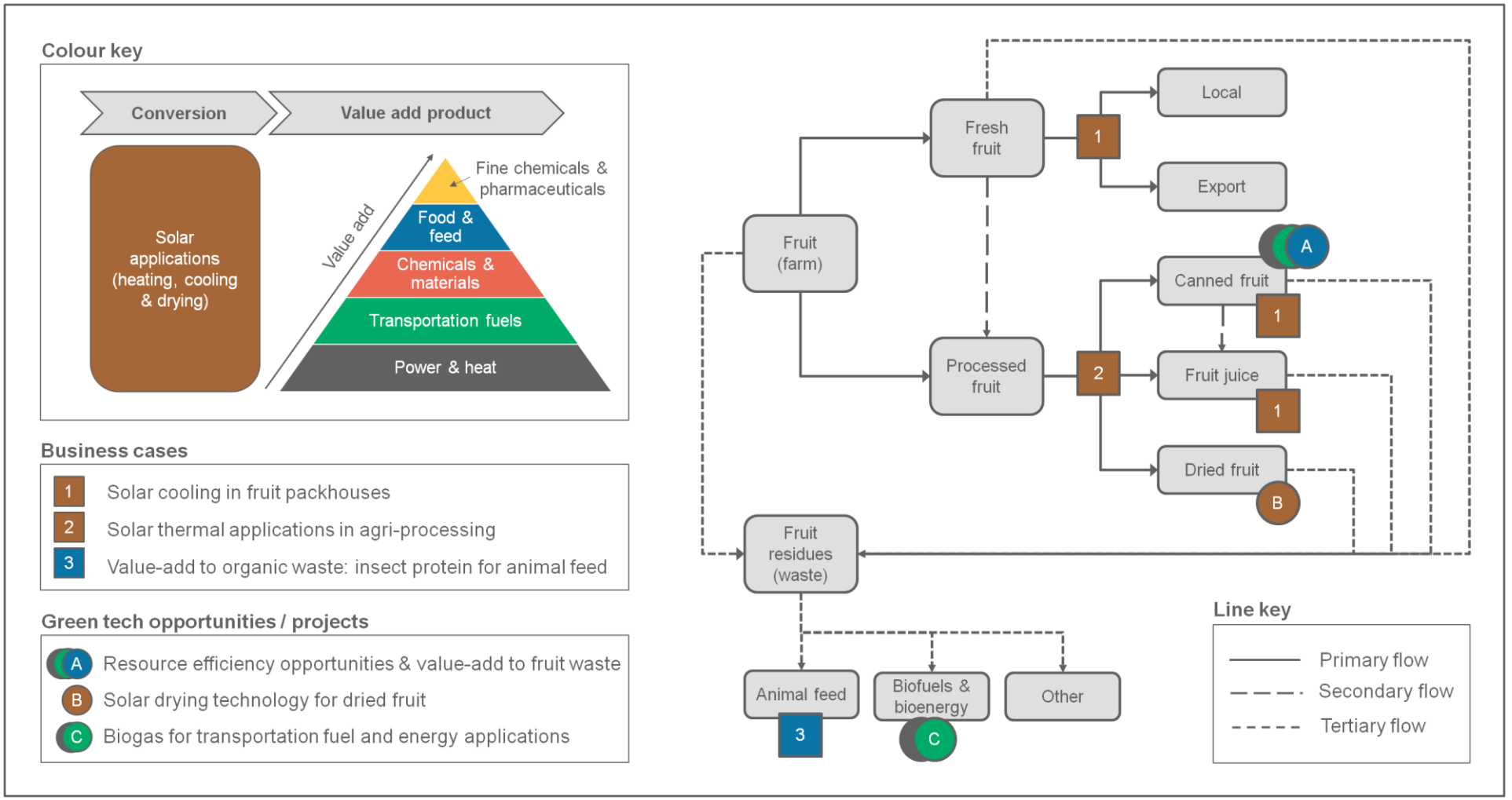

Figure 4: Business cases and green technology opportunities mapped onto a schematic diagram of fruit flows within the sector

1.6. Potential impact of green technology opportunities

The potential impact of the green technologies highlighted in the business cases and green technology opportunities is summarised in **Error! Not a valid bookmark self-reference.** overleaf. Key insights from the business cases, and overall insights and recommendations from the project are summarised below.

1.7. Key insights from the business cases

1.7.1. Business case 1: Solar PV for packhouses

Packhouses are a natural fit for solar PV application as the energy demand of a packhouse is aligned with solar energy generation i.e. majority of cooling and energy-intensive packing activities occurs during the day and in summer when solar PV generates the most electricity. Several companies have adopted the technology, however there is a lack of knowledge regarding the economic feasibility of solar PV, particularly when the business is impacted by the seasonality of products (e.g. fruit).

To address this, GreenCape developed a business case to examine the financial feasibility of installing a solar PV system for an apple packhouse using representative energy load profiles. The return on investment (i.e. payback period, net present value and internal rate of return) was examined under various scenarios. The variables for the different scenarios are summarised in Table 1 below.

Table 1: Scenarios examined within the business case

Variable	Details
Size of solar installation	500 kW_p
	≤10 kW_p
Tariff structure	George Municipality tariffs[4]
	Eskom Ruraflex tariffs
Tariff increase	13% per annum for five years then 8% per annum[5]
	10% per annum increase
Financing solution	Self-funded (full cost borne in first year)
	80% financed by 10 year loan at 10%
	80% financed by 10 year loan at 18%

The modelled results provide some key insights, specifically: (a) the impact of economies of scale is significant, with large (500 kWp) solar PV systems financially viable in all scenarios considered; and (b) financing is key to unlocking the full potential of solar PV on packhouses; even small solar PV systems (≤10 kWp) are financially viable under the right financing conditions and returns for loan-financed installations are often greater than when the finance is raised internally.

The opportunity for financing solutions is currently being unlocked by innovative performance-based contracts to help overcome capital cost constraints, with Energy Service Companies (ESCos) playing a significant role in this space. For businesses, this implies that external financing solutions may provide greater returns than self-finance when implementing solar PV solutions.

Solar PV installations on packhouses are thus worth exploring. This is clearly demonstrated through case studies of companies that have already been able to profitably implement them. Further details are available in the business case report[6]. The report also highlights the progress in development of rules and regulations to allow feed-in to the national grid and specifies where connections are currently, and soon to be, possible in the Western Cape.

[4] George Municipality tariffs were selected to represent municipal tariffs as they are expected to broadly correspond with other municipal tariffs.
[5] Based on Eskom's historical trends and the current energy crisis in South Africa.
[6] Contact GreenCape to request the business case (pieter@greencape.co.za).

Table 2: Potential impacts associated with green technology opportunities for agri-processing

Opportunity		Job creation / safeguarding	GDP contribution	Costs savings	Other benefits
Renewable energy	(a) Solar PV on packhouses	Potential for **1000 jobs** created in the manufacture of solar PV	Potential for **R1 billion** worth of installation or **>60 MW** of solar PV on 613 Western Cape packhouses.	Potential for **R103 million per annum** with a payback period of **7–12 years** depending on energy needs and scale of installation	(a) Reduced carbon emissions associated with fruit value chains (b) Improved competitiveness especially in international markets
	(b) Solar thermal applications in agri-processing	Potential for **900 jobs** created in manufacture of solar thermal systems	Potential for over **600,000 m²** of solar thermal collection area[7] in the food and beverages sector in South Africa	At least **50% of fuel costs saved** at first installation Significant scaling potential: **79%** of the energy in the food, beverages and tobacco sector is for heat	
	(c) Solar drying for dried fruit	Potential for **110 jobs** created from increased revenue in South Africa	Technology is currently under development but improved production efficiencies could generate additional revenue of **R40 million**	Unknown	Local green technology development with export potential
Renewable energy and value-add to organic waste	Biogas from organic waste	Potential for **7000 jobs in SA** Potential for **1500-2000 jobs** in the Western Cape if biogas potential from agri wastes was realised	**R400 million** in Western Cape	**Waste disposal costs avoided** This will become critical, especially for abattoir wastes, due to: (a) new regulations requiring waste to be disposed of in a limited number of landfills, and (b) a potential ban on organics to landfill	(a) Improved energy security (b) Improved management of waste (c) Provision of a clean low carbon energy source (d) Provision of valuable by-products (e) Improved competitiveness by lowering the carbon footprint of Western Cape agriculture and agri-processing products
Value-add to organic waste	Insect protein for animal feed	**260 jobs** taking into consideration direct, indirect and induced impacts on the economy	Revenue of **R230 million** Contribute **R500 million** to Western Cape GDP **(**including indirect and induced impacts)	Cost savings of **R6 million** from diversion of organic waste from landfill (i.e. avoiding disposal costs)	High-value use of organic waste

[7] Collector is a device for capturing solar radiation or heat.

1.7.2. Business case 2: Solar thermal for agri-processing

Agri-processing is a key sector in South Africa and is expected to expand. Additionally, most of the sector's energy needs are for heat (79%)[8] with most processes requiring relatively low temperatures (<150°C). This is the heat profile that solar heating systems are able to supply most economically and a number of international case studies indicate that there is a clear opportunity for these systems within agri-processing.

The potential for solar thermal installations in the agri-processing sector within South Africa could be over 600,000 m^2 (in terms of the solar thermal catchment area[9]). Furthermore, uptake has been demonstrated: South Africa's first industrial-scale solar heating project is in the agri-processing sector and has recently been completed. Cape Brewing Company (CBC), located in the Western Cape, has installed a 84 kW_{th} solar heating system with a cost saving equivalent of 105,600 kWh per annum.

With a growing interest in solar thermal applications, and the solar thermal roadmap envisioning a significant expansion of the solar heating system market, this business case highlights the opportunity for industrial-scale heating in agri-processing using solar energy. The business case provides:

- An overview of the solar thermal integration concepts.
- An overview of the solar thermal market, including:
  - Key stakeholders
  - Initiatives that drive the development of a viable local solar heating sector, and
  - Barriers for further development, including a lack of component testing.

Further details are available in the business case report[10].

1.7.3. Business case 3: Insects as an alternative protein source for animal feed

Despite growing interest in insects as an alternative protein source for animal feed and significant progress in addressing barriers (particularly in terms of access to key feed markets), there has been limited assessment of the potential impact of the opportunity for the Western Cape (and South Africa more broadly), in terms of economic development and job creation within the food value chain. To examine this, GreenCape developed a business case to highlight strategic opportunities for investment in the commercial production and processing of insects for animal feed. The report included:

- An overview of the status of the industry.
- Key drivers for and barriers to increased production and uptake of insect meal in animal feed.
- An assessment of the potential market for insect protein, including available and emerging markets and their potential market size.

The report is envisioned to provide motivation for private sector investment in, and public sector support for, insect production and processing (and its related value chains); as well as provide recommendations for the Western Cape Government in terms of creating an enabling environment for such investment, with the aim to unlock potential for economic growth and job creation. The report highlighted that the inclusion of insects in aquafeed is expected to have the greatest impact on a primary industry and the economy, given:

- The significance of the aquaculture sector and ambitious growth targets set by Operation Phakisa, an economic development initiative driven by National Government.

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[8] Taken from the 'food & tobacco' sector's final energy demand (Lampreia, 2014).
[9] Calculated using the Department of Energy's energy balance and 2.06 MWh/m^2 (taken from Mauthner, 2015).
[10] Contact GreenCape to request the business case (pieter@greencape.co.za).

- Demonstrated cost savings and improved economic viability within aquaculture; e.g. aquaculture industries in the USA have demonstrated a 16% decrease in feed costs and improved economic viability when using insects for feed.

Details on the market and key opportunities for investment are available in the business case report[11].

1.8. Overall insights and recommendations

The key insights for the uptake of green technologies in the agri-processing sector are summarised in Table 3 (for renewable energy) and Table 4 (for value-addition to organic waste). These tables include key drivers, challenges, practical enablers and strategic recommendations for the Western Cape Government (WCG).

Table 3: Key insights regarding renewable energy in agri-processing

	Solar energy	Bioenergy (e.g. biogas)
Drivers	▪ High **solar potential** in South Africa	▪ Large volumes of organic wastes currently going to **landfill** and/or poorly managed ▪ Legislation set to **increase cost of organic waste management**
	▪ Rising **energy costs** ▪ Concerns regarding long-term **energy security**	
Challenges	▪ **Knowledge** of available solutions ▪ **Lack of component testing** for solar thermal systems - limits competition	▪ **Knowledge** of and **confidence** in the technology ▪ Cost and timeframes for **regulatory compliance** (incl. waste licences / air emission permits) ▪ **Legislation** on utilisation of by-products (e.g. for fertilisers)
	▪ The viability is typically impacted by **economies of scale** and the **seasonality** of industries ▪ **Tariff and regulations for feed-in** not yet universal and require smart meters ▪ Large **capital cost** of systems limit uptake	
Practical enablers	▪ Encourage use of **energy service companies**	▪ **Streamline and rationalise regulations** surrounding the use of organic wastes & derived products / by-products
	▪ Supporting efforts to accelerate **small-scale embedded generation tariffs** for Eskom supply ▪ Accelerate development of **tariffs** in **municipalities**	
Strategic recommendations for WCG	▪ Support **local technology development**, specifically localised and improved drying technology ▪ **Raise awareness** of opportunities in industry, specifically in terms of the economic feasibility for solar PV on packhouses and solar thermal applications in agri-processing ▪ Support **component testing** of solar systems	▪ Support **local technology development**, specifically affordable small and medium-scale technologies ▪ **Raise awareness** of opportunities in industry, specifically within animal husbandry, abattoirs, dairies and piggeries ▪ Encourage **energy applications** (i.e. heat and electricity) rather than transport at this stage - WC requires natural gas infrastructure to enable large-scale biogas for transport
	▪ Support development of **smart meter standards** ▪ **Lead by example** on government-funded large-scale infrastructure ▪ **Foster linkages between industry and academia** to further enable industry-led research	

[11] Contact GreenCape to request the business case (cathy@greencape.co.za).

Table 4: Key insights regarding value-addition to organic waste

	Value-add to organic waste
Drivers	▪ Large volumes of organic wastes currently going to **landfill** ▪ **Changes to legislation** with respect to management of organic waste will put significant financial pressure on the agri-processing sector ▪ Broader consideration of value chains allows innovative and **higher value** uses of residual organic materials ▪ Support to developing these value chains could enable world-leading **R&D** and the provision of **technology** for **emerging markets**
Challenges	▪ **Cheap cost of landfill** - limits diversion of organics to higher value applications ▪ Barriers to value-add include the **legislative environment** for: – Utilisation of waste, particularly the use of **abattoir waste** for insect production – Utilisation of **by-products** (e.g. digestate for fertiliser) ▪ Current energy crisis in South Africa has driven **waste-to-energy** as the proposed solution
Practical enablers	▪ **Streamline and rationalise regulations** surrounding the use of organic wastes and derived products / by-products, specifically procurement and processing of organic waste
Strategic recommendations for WCG	▪ **Support** businesses involved in the **separation of organics** from general waste to provide sufficient feedstock ▪ Strategically **assess the relative value-add benefits** to organic waste i.e. ensure that utilisation realises its full economic development potential and drives the development of a green economy ▪ Specifically related to insect protein for animal feed: – **Support** the inclusion of insect meal in **aquafeed** – **Raise awareness** of the **benefits to aquaculture**, particularly with respect to cost savings to the industry – **Support and capitalise** on **novel R&D** and opportunities for the development of **new technology** to meet increasing scale-up demands – **Assess opportunities for export** as barriers are addressed in large markets (specifically USA and EU) – **Assess opportunities for small-scale production** in rural areas and in agri-parks

1.9. Conclusions

The project has provided key insights to enable the uptake of green technologies and support the growth of the clean technology industry (supply side) through targeted promotion in the agriculture and agri-processing sectors (demand side). Furthermore, the project has built a foundation of analytical evidence to direct strategic interventions by the WCG, to enable Western Cape agricultural and agri-processing sectors to benefit from a number of green technologies. This allows sectors and value chains to improve resource efficiency in order to remain internationally competitive, resilient in the face of climate change, provide local food security, and expand their critical role in the Western Cape economy as key generators of export revenue, employment and (rural) development.

1.10. Moving forward

The RP project will be managed with the Bioenergy project in 2016/17 under the project title “Bioenergy and resource productivity in Western Cape food value chains”. This has been done to allow the strategic thinking in these projects to be aligned.

The project has three objectives for 2016/17:

- Supporting the implementation of key opportunities identified by the RP project in 2015/16. This will include knowledge dissemination and driving enabling actions to assist in the uptake of uptake of renewable energy technologies in agri-processing, as well as resource efficiency within the food value chain (specifically through the diversion of organic waste from landfill to value-add applications).
- Strategically assessing value add opportunities for bio-based resources in the Western Cape, with a specific focus on examining the “best” use of organic waste in food value chains. This is considered important to ensure that the utilisation of this resource realises its full economic development potential and drives the development of a green economy.
- Developing a business case for a bioenergy opportunity, specifically a biogas opportunity in agriculture and agri-processing. The aim of the business case is to support potential developers of bioenergy projects by identifying success factors and barriers.