Organics: From Waste Management to Driving a Bio-Based Economy

C. Pineo, U. Gogela, P.F. Janse van Vuuren, Q. Williams, J. Lyons, I. Kuschke and L. Basson.
The GreenCape Sector Development Agency, 18 Roeland Street, Cape Town, 8001, South Africa.
Corresponding author: usisipho@greencape.co.za

ABSTRACT
A bio-based economy is an economy that primarily utilises biological resources in such a manner to support the development of a green or sustainable economy. It is thus worth examining the "best use" of biological resources in the economy in order to strategically drive the use of bio-based resources and obtain maximum value-add across these value chains. This paper discusses the opportunities and barriers to effect a shift from a "waste management" mindset for organics to a "sustainable resource use" mindset in order to drive the development of a sustainable bio-based economy. The arguments are illustrated by a number of organic waste case studies, drawing from GreenCape's work in supporting the development of the green economy in the Western Cape.

1. INTRODUCTION

1.1 Taking a value chain approach when assessing organic waste

The current energy crisis in South Africa has led to concerns related to long-term energy security and affordability. In addition, waste estimation and characterisation studies have led to the realisation that there are large volumes of organic wastes available in the country and that organics form a large fraction of waste streams going to landfill. Taken together, this has brought waste-to-energy to the fore as proposed solutions for the management of organic wastes and landfill diversion. However, at a strategic level, it is worth considering the benefits of changing from a waste management mindset to one that takes a systems approach and considers the full value chain. This has prompted questions such as "What is the best use of organics in the economy?" or alternatively "How do we ensure that we use our bio-based resources most efficiently in the economy?"

1.2 Importance to the local economy

These questions are important in the South African context, particularly when considering that: (a) the availability, quality and increasing cost of resources may limit aspirations for economic growth and job creation; and (b) recent changes to the Waste Management Act, which that allows for the reutilisation of materials (including organic waste)[1] (DEA, 2014). Where organics are going to landfill, this opens opportunities for alternative uses (e.g. composting, anaerobic digestion to enable energy recover). At the same time, where organics are diverted to animal feed, there could be opportunities for improved products (e.g. improved quality of feed) and further value-add (e.g. nutraceuticals). Such opportunities may provide greater financial security through the diversification of income streams and drive the sustainable management of resources, while contributing to job creation and driving economic growth.

1.3 The value-add hierarchy for bio-based residues

Conceptually, a value-add hierarchy (see Figure 1 overleaf), which indicates the relative value-add of different uses for organic residues or side streams, can be used to guide this thinking. Within this hierarchy, energy for electricity and heat (level 5) is considered a relatively low-value application, with higher value products derived from transportation fuels (level 4), chemicals (level 3), feed / food (level 2) and fine chemicals / pharmaceuticals (level 1) respectively.

[1] Specifically Act No. 26 of 2014: National Environmental Management: Waste Amendment Act, 2014.

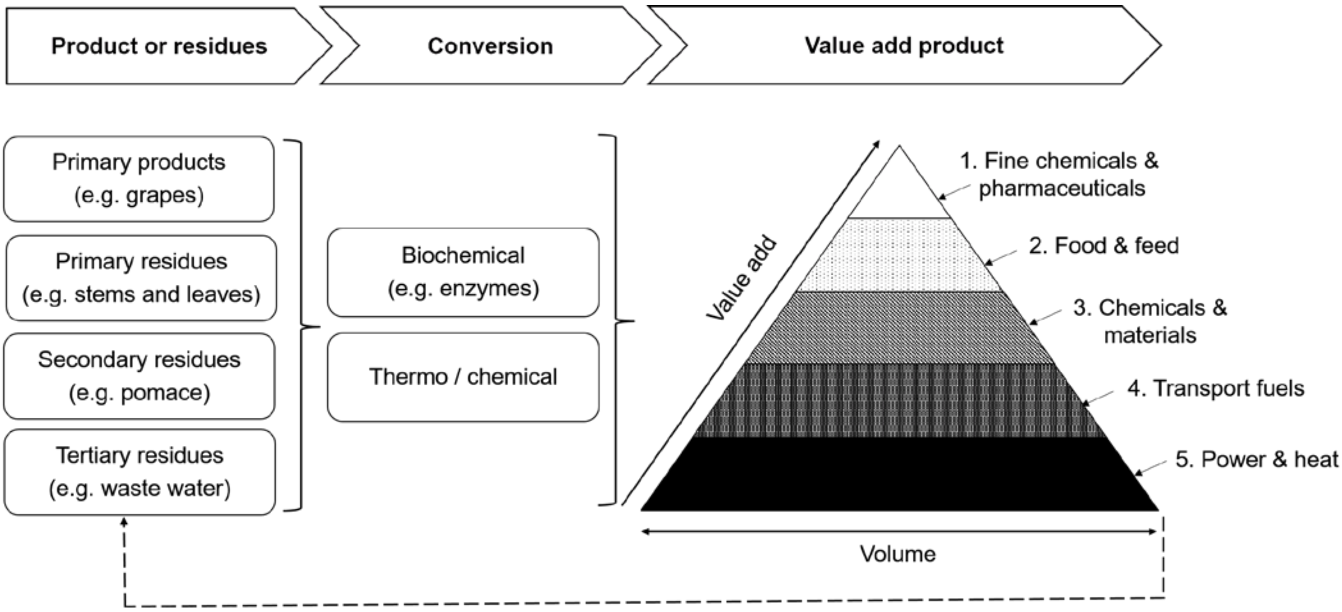

Figure 1: Value-add hierarchy for bio-based residues (adapted from the Bioeconomy Study Tour, Netherlands Department of Foreign Affairs, 2015).

1.4 Objective

A scoping study is being undertaken in the Western Cape to identify alternative uses for residual organics in the food value chain, with the aim to identify alternative uses that would have greater economic development and job creation benefits. The study takes a systems view to ensure that there are net benefits to the economy and the environment. For example, if directing organic residues that are currently going to animal feed to another use, then the effect of both the new use (and what it might displace), as well as the replacement of the animal feed would need to be considered.

Ideally, opportunities for further or multiple value-add are sought to enable the maximum value to be gained from organic residues. In order to critically assess the different opportunities for value-add to organic residues available, the value-add hierarchy for bio-based residues (depicted in Figure 1) is used as a heuristic guide to determine the relative merit in terms of value-add of different uses of bio-based resources. This is expected to direct the evaluation of opportunities in the scoping study, with the view to guide policies, strategies and interventions to enable the maximum value to be extracted from bio-based residues in the Western Cape.

This paper specifically presents a number of case studies that have been evaluated in terms of value-add activities and considers the drivers for their initiation, and potential barriers to scaling these and other value-add opportunities in the Western Cape economy. The paper thus also examines each of the opportunities in terms of relative value-add with reference to this hierarchy. In the broader scoping study, the validity of this heuristic guide in the Western Cape context is also to be verified.

2. DRIVERS AND BARRIERS FOR VALUE-ADD

2.1 General drivers

Within South Africa, the major drivers for the management of organic waste are cost savings and, in the case of waste-to-energy applications, improved energy security. However, innovative businesses have recognised the value within organic waste and are capitalising on opportunities to add further value and generate additional and/or diversify revenue. This interest in value-add has also been driven by the development of more stringent waste regulations, as the diversion of waste to landfill as a waste management strategy, particularly for abattoir waste, becomes practically and financially unfeasible.

2.2 General barriers

The need for efficient waste management and the ease and relatively cheap cost of landfill makes landfill a financially justifiable and least disruptive choice for organic wastes, especially in urban contexts. The short-term pressures[2] on energy availability and security tend to make waste-to-energy appear as an attractive alternative. This is reinforced when considering the international context (especially in Europe and Japan) where waste-to-energy has been a primary strategy for landfill diversion. There is also strong "technology push" from countries with experience in waste-to-energy without recognising several fundamental differences in the contexts (e.g. density, economies of scale, lack of financial incentives and saleability of by-products such as heat to enable financial feasibility). Overall, these encourage a mindset that looks for (cheap) waste management solutions, rather than seeking value-add opportunities

Another key barrier to uptake of value-add is the national legislative framework. Although changes to the National Waste Management Act through the Waste Amendment Act No. 26 of 2014 (DEA, 2014) encourage the re-use, recycling or recovering of material previously classified as waste[3] and can thus be viewed as a driver for value-add, efforts to secure and process organic waste have proven challenging in practice. Many project developers have cited the cost of obtaining licences and the extended timeframes associated with the processes (often leading to challenges to obtain finance for projects) as a key barrier to uptake.

Other important barriers include:

- Feedstock insecurity i.e. obtaining sufficient feedstock is challenging given alternative (and competing) uses for feedstock (e.g. animal feed, compost, biogas).
- Insufficient economies of scale, which is critical for financial feasibility.
- The cost of logistics, which is a strong factor driving the provision of feedstock and thus limits the economic feasibility of operations. Feedstock is generally widely distributed, thus requiring aggregation to obtain economies of scale; however, the cost of transport makes aggregation beyond the immediate surroundings too expensive.
- Lack of markets (e.g. for excess energy, fertilizer, value-add products) which would be required for financial feasibility. The reasons for this are numerous and depends on the value-add option, but include (local) scale of and access to markets, as well as acceptability or familiarity of the service/product as an alternative to other established services/products.

3. CASE STUDIES: VALUE-ADD TO ORGANIC WASTE

Several case studies encountered by the GreenCape Sector Development Agency through a range of projects and activities demonstrate how different bio-based residues have been utilised for higher-value applications. These case studies are outlined within this section (Section 3). The specific drivers and barriers for the case studies are summarised in Table 1 in Section 4.

3.1 Value-add to wine grape pomace and lees: production of raw materials for the chemical and pharmaceutical industry and waste-to-energy

This case study demonstrates how a company uses a bio-refinery approach (multiple product extraction from biomass, analogous to an oil refinery) to extract value from a specific industry waste. The value-add company was initially established in the 1960s and collected filter cakes from the wine industry for export to Germany, where it was used for the production of tartaric acid. Since then, the company has expanded its operations to add value to several by-products from South Africa's wine industry, specifically grape pomace (the solid remains of the pressed grapes, including the skins, pulp, seeds and stems of the fruit) and the wine lees waste (the solids remaining after clarifying wine via settling or centrifugation). The company currently

[2] These short-term pressures are not envisaged to continue in the long-term and thus the natural ordering of the value-add hierarchy is expected to hold.

[3] Legislation considers waste as "any substance, material or object, that is unwanted, rejected, abandoned, discarded or disposed of, or that is intended or required to be discarded or disposed of". However, amendments state that any material ceases to be waste if it is re-used, recycled or recovered, or once an application for its re-use, recycling or recovery has been approved. Thus, if "waste" material is used for a licenced value addition process, then it no longer needs to be treated as a waste further down the value chain.

processes 70% of winery waste within the Western Cape and produce a wide range of value-added products, many of which are exported to Europe, North and South America, Asia and Australia. These range from high-value antioxidants from grape seed extracts to lower value chemicals, specifically the production of calcium tartrate (which is used as a raw material for the production of tartaric acid), as well as alcohol and grape seed oil. Furthermore, the post-processing residues (i.e. the material left behind after the valuable extracts have been drawn from the skin and seeds) are then dried, compacted and either sold as animal feed, or burnt as a fuel in the factory boilers and then recycled as compost.

Key success factors are the specialised and diverse product range and access to the large local wine industry, which provides a reliable feedstock supply of pomace and lees waste, as well as providing the demand for several of the by-products, specifically grape alcohol. The company supply raw materials to international markets (specifically calcium tartrate) and, through supplier contracts, are able to import final products (specifically tartaric acid which cannot be competitively produced in South Africa) at a lower price than other potential competitors. This business model demonstrates the benefit of a value-chain approach to waste management: it extracts value from another industry's waste as well as maximising extraction of value from its own by-products. There also appears to be a cascading of materials from higher value uses (antioxidants, food products) to lower value uses (waste-to-energy).

3.2 Value-add to apricot and peach pips: production of raw materials for chemical and food-based products and waste-to-energy

A large fruit and vegetable cannery has collaborated with companies within its supply chain to add value to waste from its processing facility, including apricot and peach pips. The canning company sell the pips to a third party, which then dries them and then extracts the high-value apricot kernels from the shells. The kernels are exported and either sold as food or further processed into persipan (a substitute for marzipan), while the shells are then further processed to be used as granular polishing agents. Unprocessed shells are also used as ground cover, with applications in landscaping, and a portion of the dried peach pips and shells are returned to the canning factory where they are mixed with coal and used to fuel the boilers. Key success factors are the economies of scale, mutual economic benefit for both companies and the established market for apricot kernels. This case study demonstrates that all components of the pip residues are used, with a production mix of higher-value and lower value products, depending on the nature of the material (higher value uses for kernels, lower value uses for shells).

3.3 Value-add to agri-processing and post-consumer organic waste: production of insect protein for animal feed[4]

Insects can be reared on and convert low-value organic waste into high-value protein. This protein can be used as an alternative to fishmeal and soymeal, which are presently the major components used in feed formulae for aquaculture and livestock. The opportunity for insects to meet the rising demand for animal feed is considered to be significant (FAO, 2013), and the business case is primarily driven by the cost-competitiveness and suitability of insect meal relative to fishmeal, as well as the increased acceptance by industry, especially within the aquaculture sector.

The cost-competitiveness is a key driver for this value-add opportunity, as the current price for insect meal is lower than that for fishmeal. This is particularly advantageous for livestock and aquaculture as a major constraint to increased production is the prohibitive cost of animal feed (FAO, 2013). Furthermore, the suitability of insect meal has been demonstrated in livestock and fish feeding trials: results indicated that insects could potentially replace 25% to 100% of fishmeal or soymeal in poultry, pig, fish and crustacean feeds (Makkar, 2014). In addition to these drivers, there are several environmental benefits compared to the production of traditional sources of protein. Environmental benefits are primarily linked to the utilisation and reduction of organic waste (and thus mitigation of negative environmental impacts), and the lower resource intensity of production, particularly when used as an alternative for irrigated plant-based sources (FAO, 2013).

Success factors include utilisation of a relatively secure and cheap feedstock supply, with suppliers incentivised by the economic benefits provided by diverting waste from landfill, as well as the unique

[4] GreenCape is developing a business case for value-add to organic waste through the production of insect protein for animal feed. Contact cathy@greencape.co.za for more detail.

marketing benefits associated with supporting this high value application. A South African company has taken advantage of the emerging (and niche) market for insect protein and have collaborated with academia to lead commercial-scale production of insects for animal feed. This company, along with several others internationally, have provided evidence that large-scale production of insects is increasingly economically feasible. Furthermore, cultural and legislative challenges are currently being addressed in key feed markets, specifically in the USA and European Union.

The diversion of organic waste to support insect production and processing is thus an example of a value-add that supports the development of a green economy and provides a strategic use of bio-based residues for multiple economic benefits. This case study also illustrates the benefit of a further value-add step prior to directing materials to animal feed. If used directly, the organics have some nutritional benefit (primarily as carbohydrates). However, if used to produce insects for feed, the product has a higher nutritional benefit (protein), while also producing value by-products (e.g. residues that can be used directly as a fertiliser).

3.4 Value-add to fruit organic waste: production of liquid organic fertiliser and biogas for heat and energy applications

A juicing company uses a mixture of organic wastes to produce biogas in an anaerobic digester (AD). The gas produced is used to run a combined heat and power system (CHP) generating electricity, thereby reducing the electricity costs to the production facility. The heat generated is used to produce process steam for the adjacent production plant, leading to further cost savings in the form of avoided fuel costs. In addition, the liquid digestate can be irrigated and used as an organic fertiliser; however finding off-takers for this by-product can be challenging.

This approach to waste shows that the juice company sees the AD facility not just as a waste management solution, but as a value-add mechanism, allowing them to ensure their own energy security while also acting as a service provider for waste management for other companies and selling a nutrient-rich digestate product. The business case is reliant on replacing on-site energy use (heat and electricity) and/or securing a private energy off-take, either through wheeling electricity via the grid, through use of heat at an adjacent site, or gas bottling procurement. It is also reliant on off-take of the digestate and securing appropriate feedstock in addition to the company’s own waste (which is dependent on availability of organic waste and logistic costs associated with procurement).

3.5 Value-add to animal manure: production of energy (electricity and heat) as well as improved waste management

An anaerobic digestion project (nearing completion of construction) will have symbiotic benefits for a cheese production factory and an adjacent piggery. Currently, the manure effluent from the piggery is sent to maturation dams without treatment. After plant commissioning, the pig manure slurry will be used as a feedstock in an anaerobic digester, thereby improving wastewater effluent quality. The gas produced will be used in a CHP system to offset electricity and diesel (for heating) requirements of the cheese factory, resulting in energy cost savings.

Similarly, a dairy farm uses cattle manure as feedstock for a biodigester. This energy supplements the requirements of a feed mill and the dairy operations. The resultant electricity savings provide significant cost savings and will pay back the initial capital cost in timeframes on par with other large-scale agricultural infrastructure. Additionally, the composted digestate product is used as animal bedding for the cattle.

The above case studies illustrate suitability of a low-value, tertiary residue (manure) as a suitable feedstock for the base of the value-add hierarchy, generating higher value products (electricity, heat, organic fertiliser, animal bedding) from a low-value input whilst at the same time providing improved waste management.

3.6 Value-add to abattoir organic waste: production of compost (solid organic fertiliser)

An abattoir uses a composting process to treat abattoir waste generated on-site from the slaughtering of sheep. The abattoir also accepts suitable organic wastes from external parties and charges a gate fee at a rate considerably lower than the landfill gate fee. The composting process was driven by a need for alternative, appropriate and cost-effective treatments for abattoir waste, which generally consists of soft animal tissue and blood.

This is a direct result of stricter waste management regulations for abattoir waste, specifically outlined in the National Norms and Standards for the Disposal of Waste to Landfill (GNR 636; DEA, 2013)[5]. The outcome of this is an increased cost of waste disposal at landfill, in part through increased logistic costs to suitable class B landfills and increased waste management costs. The business case for composting was further supported by the production of a valuable nutrient-rich soil enhancer, which can be sold and used in agriculture, as well as additional income from gate fees. This case study illustrates the need for effective waste management and demonstrates how legislative pressures (such as stricter requirements for landfill) can act as drivers for resource-efficient use of organic wastes.

3.7 Value-add to sawdust: production of compost (solid organic fertiliser)

Wood processing facilities use multiple types of wood. During the process of “planking” sawmills generate significant amounts of sawdust and wood shavings, which are considered to be a fire hazard and require immediate attention in terms of safe disposal. Other sources of sawdust are the many furniture manufacturers in the Western Cape region, some of which utilise medium density fibreboard (MDF) as a raw material for their furniture. This creates a problem for disposal, as this sawdust is considered to be ‘contaminated’ with bonding agents. This limits the ability to undertake further value addition as it is potentially toxic to the environment.

To date, only the ‘uncontaminated’ version of sawdust has benefited from value-add initiatives. One such initiative is composting. Composting requires there to be a balance between the amount of carbon, nitrogen and water in the feed material. Sawdust has a high carbon content, but is lacking in both nitrogen and water. This makes it an ideal additive to a traditional compost heap requiring carbon, while also adding to its value. Currently, a company in the Western Cape region collects and utilises sawdust from multiple sawmills and furniture manufacturers for use as a carbon additive to their compost. Not only does the sawdust aid in the process of aerobic digestion, but it also acts as a “bulking agent”, which in turn has an economic benefit, provided the carbon to nitrogen ratio (C:N) is correct.

3.8 Value-add to alien invasive vegetation: production of biomass-for-energy

Within the Western Cape, water security is chiefly affected by two parameters: rainfall and alien vegetation. For this reason, it has become a priority for the Western Cape government to implement strategies for the removal and management of alien vegetation in affected areas. These management practices are costly and require significant funding, hence the need for the development of a value-add strategy to offset the cost of removal.

The key driver for value-add is to offset the operation costs to clear alien vegetation and enhance the economic viability and thus sustainability of the clearing programmes. Furthermore, the chipped material is considered to be a fire hazard if left on site and energy-related value-add options could provide small-scale and decentralised energy production for farms. The business case is supported by a demand for environmentally-friendly boiler fuel (particularly in overseas markets), the availability of feedstock and a high cost of disposal to landfill (particularly when considering that alien vegetation clearing occurs in rural areas and there will be high logistic costs associated with landfill disposal).

Value-add initiatives range from furniture manufacture to chipping (for use as a gravel substitute or boiler fuel) to the production of activated carbon and biochar. Generally a combination of these value-add initiatives has shown to yield the greatest economic benefit. However, with the commissioning of a biomass boiler near the Cape Town CBD, a market has been created for alien vegetation, which is first chipped and then used as a fuel source. Use in boilers such as this has so far proven to be the most reliable solution to alien vegetation waste. The advantages of such a solution include the relative ‘flexibility’ of the technology with respect to the fuel requirements, as well as the high consumption capability of the boiler, which allows rapid large scale use thus enabling the reduction of fire risks on invasive alien vegetation clearing sites. This solution may not exhibit the most value-add potential, but it again adds value to a ‘waste’ stream, which originally had no value.

[5] National Norms and Standards for the Disposal of Waste to Landfill (GNR 636) list that abattoir waste (non-infectious animal carcasses) need to be sent to class B landfills (DEA, 2013).

4. DRIVERS AND BARRIERS FOR THE CASE STUDIES

Specific drivers and barriers for the case studies are detailed overleaf in Table 1. The Table also provides an indication of value-add to the bio-based residues by providing the hierarchy level, which is shown in Figure 1.

Table 1. Summary of the drivers and barriers to value-add within the case studies.

Case study	Input	Output	Hierarchy level	Drivers	Barriers
Value-add to wine grape pomace and lees: production of raw materials for the chemical and pharmaceutical industry and waste-to-energy	Grape pomace and lees	Grape seed extract	1-2	• Market: Contains a valuable antioxidant used in nutraceutical or nutritional supplements.	• Quality: Stringent quality requirements.
		Grape seed tannins	1-2	• Market: Applications in the nutraceutical and wine industry.	• Quality: Stringent quality requirements.
		Grape seed oil	1-2	• Market: Crude grape seed oil is sold to refineries. Refined oil has applications in both culinary and cosmetic fields.	• Competition with alternatives: Culinary applications compete with large canola and sunflower markets. • Viability: Cosmetic applications require economies of scale and IP development.
		Wine spirits (grape ethanol)	2	• Local market: Crude alcohol is sold for redistillation and used in the brandy making process. • Viability: Economies of scale and centralised processing plant is located optimally to try limit logistics costs.	• Viability: Expansion will require an increase in logistic costs.
		Tartrates: Calcium tartrate and cream of tartar	2-3	• International market for calcium tartrate: Intermediate product used to manufacture tartaric acid. • Local market for cream of tartar: Used in several large industries e.g. wine, pharmaceutical and food industries.	• Viability: Large economies of scale needed to be profitable. • Viability: Currently not economically feasible to manufacture tartaric acid locally. It is imported for use by the local winery market.
		Grape skin pellets (post-extraction)	2-3 & 5	• Markets: Processed grape pomace is easier to digest than unprocessed grape pomace and can be used as animal feed for cattle, sheep and ostrich. It is also used for compost. • Alternative energy source: Can be used on-site as a fuel for boilers.	• Consumer perceptions / lack of awareness: The benefits of using processed grape pomace are not widely known or trusted.

Value-add to apricot and peach pips: production of raw materials for chemical and food-based products and waste-to-energy	Apricot and peach pips	Apricot kernels	3	• International market: Kernels provide raw material for the manufacture of persipan (also known as parzipan) – a marzipan substitute.	• Viability: Energy costs to crack and dry pips. • Viability and expertise: Currently not economically feasible to manufacture persipan locally due to poor economies of scale and complexity of managing by-products from production (specifically cyanide).
		Shell granules	3	• Diverse markets: Can be used in a variety of industries e.g. in cosmetics as a natural exfoliate, in manufacturing as an abrasive for polishing fine metals and alloys, cleaning surfaces, stripping paint etc.	• Quality: Stringent quality requirements for cosmetics. • Lack of awareness: limited local demand for organic abrasives.
		Dry shells	3 & 5	• Market: Used as ground cover/paving or for fuel in boilers. • Cost and availability: Low cost, available material.	• Energy efficiency: Lower thermal efficiency than coal.
Value-add to agri-processing and post-consumer organic waste: production of insect protein for animal feed	Agri-processing and food waste (organic waste)	Feed components: high-protein insect meal	2	• Growing market: Increasing demand for a cheaper protein alternative to fishmeal for animal feed. • Local economic benefits: Production of a high-value product from low-value (and often problematic) organic wastes, with knock-on benefits including diversion from landfill and cost savings for business from avoided waste disposal costs. Also provides opportunity to lower local feed (and thus production) costs. • Generate export revenue: Potential to increase export revenue, driven by large emerging markets for insect protein in Europe and North America. Also provides an opportunity to develop world-leading and exportable technology to upscale insect production and processing.	• Energy concerns: The current energy crisis in South Africa, which has driven waste-to-energy as the proposed solution for organic waste management • Lack of awareness of the nutritional suitability, sustainability and cost effectiveness of insect meal • Challenges related to scale-up and improved production efficiencies for insect production and processing • Legislation: The legislative environment for the: (a) utilisation of waste, particularly the use of abattoir waste for insect production, and (b) utilisation of by-products (e.g. for fertiliser).
		Feed components: high-lipid fraction from insect processing	2		
		Natural fertiliser	3		
Value-add to fruit organic waste: production of	Organic wastes (animal manure,	Digestate (liquid)	3	• Legislation and waste management costs: More stringent waste management regulations and increasing cost of waste disposal (particularly for abattoir wastes).	• Lack of information regarding suitable alternatives to current abattoir waste treatment protocols and the business case required.

liquid organic fertiliser and biogas for heat and energy applications	plant-based residues, spoiled food, wastewaters)	Biogas (energy) and heat	5	• Energy costs: Increasing energy costs which can be offset on-site or on adjacent sites (this has been demonstrated at a dairy with a feedmill and through a symbiotic agreement between a piggery and cheese factory). • Load shedding/lack of energy security. • Improving wastewater effluent quality (e.g. manure effluent from a piggery is used as a feedstock in an anaerobic digester, thereby improving wastewater effluent quality in comparison to the use of maturation ponds). • End use for by-products: Composted digestate product can be used as animal bedding for dairy cattle	• Legislation: Licensing procedures, time required for licence approval, legal costs associated with licensing and lack of stakeholder understanding with respect to the associated procedures. • Lack of clarity with regard to power purchase agreements and electricity grid feeding (especially for small scale embedded generation).
Value-add to animal manure: production of energy (electricity and heat) as well as improved waste management	Organic wastes (primarily animal manure)	Digestate (liquid)	3		
		Composted digestate (solid)	3		
		Biogas (energy) and heat	5		
Value-add to abattoir organic waste: production of compost (solid organic fertiliser)	Organic wastes (soft animal tissue, chicken litter, paper pulp and others)	Compost	3	• See drivers above.	• See barriers above.
Value-add to sawdust: production of compost (solid organic fertiliser)	Sawmill residues	Compost	3	• Increasing costs: Electricity and waste disposal • Load shedding/lack of energy security. • Market: Demand for wood pellets (e.g. for biomass boilers).	• Viability: Economies of scale.
		Wood pellets for energy	5		
Value-add to alien invasive vegetation: production of biomass-for-energy	Alien vegetation clearing	Biochar / activated carbon	3	• Viability: High cost of clearing requires offset by value-add. • Safety: Woody biomass from alien clearing can be a fire hazard if left on clearing sites. • Increasing electricity costs. • Load shedding/lack of energy security.	• Viability: Cost of logistics and technology, as well as economies of scale. • Long-term security of feedstock supply.
		Wood chips for energy	5		

5. CONCLUSION

The case studies presented here demonstrate a range of value-add opportunities to organic residues that are already being realised. It is of note that a number of these opportunities are in the higher value levels (1, 2 and 3) of the value-add hierarchy. These occur where a strong business case can be made. In general, the business case is stronger, and the resource efficiency of value-add opportunities greater, when cascading of organics from higher to lower levels of the hierarchy to produce multiple products occurs.

However, an important aspect to consider when assessing the business case for value-add is the demand for a product i.e. there is a need to assess investment in value-add from a market “pull” perspective, rather than a “push” perspective. The importance of this driver was highlighted within several case studies, particularly for high-value products (see drivers in Table 1). Product demand also needs to consider access to the market, the competition (and thus relative competitiveness) and the financial viability of production.

There is potential for value-add opportunities, despite several barriers in the South African context that make reaching the higher value-add tiers challenging; specifically the lack of economies of scale, cost of logistics for aggregation and access to markets. Realising this potential could be much aided by a more enabling regulatory environment, particularly in terms of alignment of regulations covering different aspects of operations. This includes: (a) enabling greater efficiencies of licence processes; and (b) opening up opportunities for the sale of by-products to improve the business case for value-add opportunities. The business case will also be strengthened by increased cost of landfill, among others, to provide an incentive for considering alternatives.

However, what is required in parallel to developing an enabling environment is a shift in mindset, from that of needing to find waste management solutions (that may well be easier to implement) to one of realising value-add opportunities (such as those presented in this paper). The value of this mindset has been clearly shown by the case studies in this paper and can bring multiple benefits to businesses and to the South African economy as a whole.

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