Market Development Strategy for FOGO-Derived Products

Waste Authority

16 June 2021

→ **The Power of Commitment**

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Printed date	16/06/2021 11:13:00 AM
Last saved date	16 June 2021
File name	https://projectsportal.ghd.com/sites/pp18_03/marketdevelopmentstr/ProjectDocs/12541803-0_Market Development Strategy.docx
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Client name	Waste Authority
Project name	Market Development Strategy for FOGO Derived Products
Document title	Market Development Strategy for FOGO-Derived Products
Revision version	Rev 0
Project number	12541803

Document status

Status Code	Revision	Author	Reviewer		Approved for issue		
			Name	Signature	Name	Signature	Date
S3	A	S Isbister L Nordin T Woods	T Woods		M Gravett		31/05/2021
S4	0	S Isbister T Woods	T Woods	pp	M Gravett		16/06/2021

The Power of Commitment

Executive summary

The Waste Avoidance and Resource Recovery Strategy 2030 (Waste Strategy 2030) aims for Western Australia to become a sustainable, low-waste, circular economy in which human health and the environment are protected from the impacts of waste. The Waste Strategy 2030 identified organic waste as a focus due to the quantities generated and associated impacts on the environment. A key commitment was pursuing better practice waste management, including roll out of a consistent three bin kerbside collection system, which includes separation of food organic and garden organic (FOGO) waste from other waste categories, by all local governments in the Perth and Peel region by 2025.

The Waste Authority established a FOGO Reference Group to develop a plan for the introduction of FOGO collection services. The FOGO Reference Group, with stakeholders from local and state governments, and the organics recycling sector, identified market development as critical to successful roll out of FOGO services.

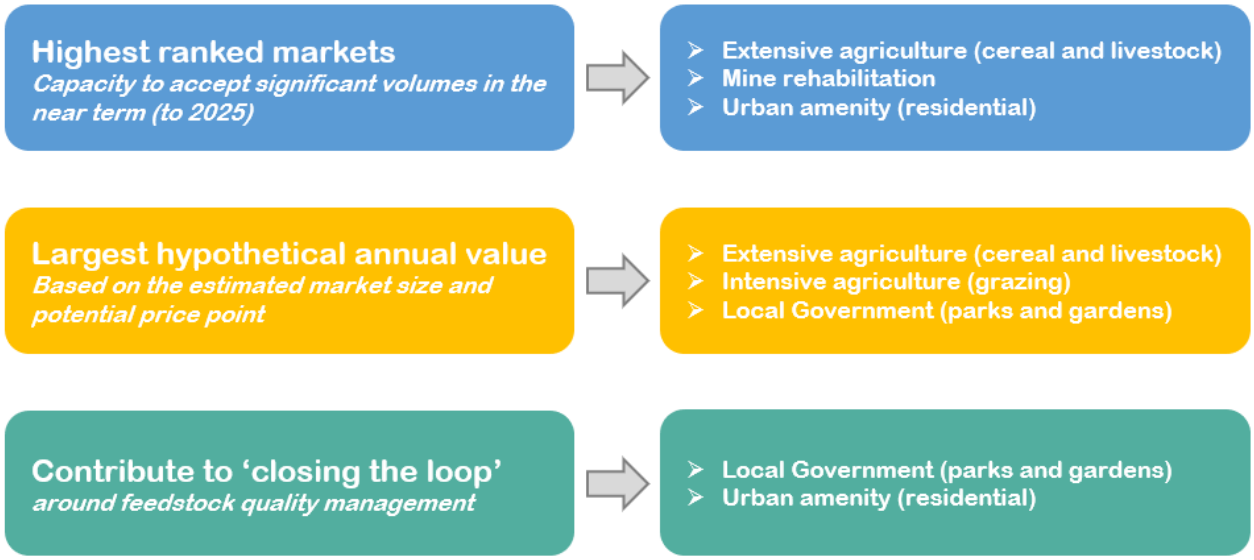
The WA Waste Authority, through the Department of Water and Environmental Regulation (DWER), engaged GHD to develop a Market Development Strategy for FOGO-Derived Products (the Strategy) to guide subsequent market development actions to 2025.

The purpose of this document is to guide the Waste Authority in identifying priority next steps to develop and maintain end-markets for FOGO-derived products in Western Australia building on the Waste Strategy 2030.

The Strategy has been developed in consultation with stakeholders in government, industry and potential end-users. Feedback from market participants obtained through surveys and interviews has confirmed strong interest in FOGO-derived products as end-users seek to improve soil health, plant establishment, production system performance and resilience, and realise overall cost savings.

To support the Waste Authority in achieving its 2030 vision that "Western Australia will become a sustainable, low-waste, circular economy in which human health and the environment are protected from the impacts of waste" (Waste Authority 2019), GHD has developed a list of actions to overcome key market barriers, and which align with the recommendations that have emerged from this study. Importantly, the Strategy aims to ensure that initial actions are targeted towards markets able to utilise the largest volumes of FOGO-derived products, to achieve consistent market demand and avoid stockpiling of products.

Five key market sectors were identified from market research: urban amenity/landscaping, extensive agriculture, intensive agriculture, rehabilitation, and remediation (refer to Section 2.2). Sub-markets within these sectors were ranked using a process of Multi-Criteria Analysis (MCA) with priority focus on markets with capacity to accept significant volumes in the near term (to 2025), allowing parallel development of niche and higher value markets for a broader range of products, over time. An overview of key findings is presented in the graphic below.



Key barriers identified for Local Government included:

- Unwillingness of Councils to take responsibility for feedstock contamination
- A lack of sustainable procurement action by State and Local Government

Key barriers identified for organics processors included:

- Perception of high contamination and processing costs leads to reluctance to process FOGO
- Perception that FOGO processing is cost prohibitive due to investment uncertainty resulting from incomplete policy and regulatory framework

Key barriers identified for markets included:

- Perception that FOGO-derived products would be contaminated, limiting market demand
- End markets are not aware of cost and other benefits from using FOGO-derived products, leading to perceived lower price points and pricing uncertainty for processors
- Regulatory framework – perception that Australian Standard AS4454 is insufficient to regulate the process.

Higher priority next steps (suggested actions) have been developed to address these key barriers relating to contamination, regulatory policy uncertainty, market perceptions, and lack of familiarity with or understanding of FOGO-derived products and their potential benefits. The recommended actions are designed to support Councils and organics processors through guidance, education, and funding to promote a circular waste economy, focusing on the recycling and beneficial use of FOGO materials. Some examples are provided below.

MARKET CONSULTATION	Undertake targeted consultation with priority markets to identify purchasing protocols that may need revise purchasing protocols (e.g. government entities)
GUIDANCE	Finalise and issue Guideline: Better Practice Composting Develop guidelines for Councils and organics processors to implement best practice management to manage contamination of FOGO feedstock and products Implement the 'end of waste' framework – Waste derived material determinations (or similar instrument) Develop guidance (informed by trials) for application of FOGO-derived products
EDUCATION	Develop a platform / forum / webinar series for Regional Local Government, Local Government and processors to share learnings Develop a state-wide approach to education around FOGO
FUNDING / SUBSIDIES	Funding for trials to assess performance (cost and other benefits) of FOGO-derived products Funding to assist processors in transition to FOGO to produce consistent, high quality, market appropriate products Introduce short-term subsidies/discounts to target markets to incentivise uptake of FOGO-derived products Establish regional temporary storage facilities for FOGO-derived products to increase transport efficiencies and reduce transport cost where purchase commitments exist
REGULATORY MECHANISMS	Amend current regulatory and policy framework to address FOGO contamination Introduce mandatory audits and data sharing for both Local Councils and organics processors to drive improvements in contamination management and product quality Mandate targets for procurement of minimum recycled content by State Government Departments and Local Governments Tighten existing standards / specifications to improve the consistency and quality of FOGO-derived products Develop new standards / specifications for FOGO-derived products which meet market expectations for quality and risk (contamination) tolerance Increase the landfill levy to further disincentivise landfill disposal of recyclable organic material (e.g. FOGO) Explore regulatory control mechanisms for reducing use of persistent and slow-to-degrade chemicals in commercial and residential garden and turf maintenance.

This Report is subject to, and must be read in conjunction with, the limitations set out in Section 2.1 of Appendix A and the assumptions and qualifications contained throughout the Report.

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1. Introduction

1.1 Setting the direction

This Market Development Strategy for FOGO-Derived Products (the Strategy) informs and guides the Waste Authority on how to pursue market development actions with a focus on producing FOGO-derived products that are suitable for their intended purpose and align with market expectations. Importantly, it aims to ensure that initial actions are targeted towards markets able to utilise the largest volumes of FOGO-derived products, to achieve consistent market demand and avoid stockpiling of products.

The Strategy has been developed in consultation with stakeholders in government, industry and potential end-users. Feedback from market participants obtained through surveys and interviews has confirmed strong interest in FOGO-derived products as end-users seek to improve soil health, plant establishment, production system performance and resilience, and realise overall cost savings.

To support the Waste Authority in achieving its 2030 vision that "Western Australia will become a sustainable, low-waste, circular economy in which human health and the environment are protected from the impacts of waste" (Waste Authority 2019), GHD has developed a list of actions to overcome key market barriers, and which align with the recommendations that have emerged from this study.

1.2 Purpose

The purpose of this document is to guide the Waste Authority in identifying priority next steps to develop and maintain end-markets for FOGO-derived products in Western Australia building on the Waste Strategy 2030.

Consequently, GHD has not set a vision, targets, timeframes, or made recommendations on what actions should be considered highest priority.

1.3 Our approach

GHD developed this Strategy through:

- Market research to understand current national and international lessons learnt for the management of FOGO to identify successful product market alignment strategies. Market research is presented in Appendix A.
- Consultation with stakeholders: government (including regulatory bodies, local/regional governments), organics processors and end markets (existing and potential), through an online survey and follow-up interviews. This information is not appended to the Strategy to preserve the anonymity of participants.
- A review of market opportunities, including consolidation of key insights and market ranking, and mapping target market regions to guide the Strategy focus. Appendix B details the markets Multi Criteria Analysis.
- Estimating potential market size and proximity to processors and aggregation points. Appendix B details the approach to determining market size and proximity.
- Developing this Strategy document, bringing together the work to guide the Waste Authority on how to develop markets for FOGO derived products.

An overview of key Strategy content is presented in Figure 1.

Figure 1 Key strategy content

1.4 Our starting point

Organic waste is a significant component of residual household waste. Recycling organic materials is a key priority in Australia's transition to a circular economy. There is now strong momentum to increase uptake of FOGO services nationally, with state and territory Environment Ministers agreeing in principle in April 2021 to support FOGO collection roll-out in all jurisdictions[1].

Currently only five Perth and Peel councils offer a FOGO service. This is expected to grow to 33 councils in line with the Waste Strategy 2030 commitment to "*Roll out a consistent three-bin kerbside collection system including separation of FOGO from other waste categories, by all local governments in the Perth and Peel regions by 2025".* Based on projections made by DWER and reviewed by their FOGO Reference Group, the proposed roll out of FOGO services in the Perth and Peel region is expected to capture around 410,000 tonnes per annum (tpa) of FOGO waste by 2025, producing around 145,000 tpa of FOGO-derived material.[2]

This Strategy builds on findings from the 2007 "Assessment of Markets for Recycled Organics in Western Australia" prepared by Research Solutions on behalf of the WA Government. In 2007, the majority of WA's recycled organic products were derived from separately collected food organic (FO) and garden organic (GO) wastes from both municipal and commercial sources, biosolids, manures, agricultural wastes and forestry residues. At that time, most recycled organics were sold into urban amenity (87.9%), with smaller quantities sold to extensive agriculture (5.9%), intensive agriculture (4%), rehabilitation (1.4%) and environmental remediation (0.7%) market sectors.

With the roll-out of FOGO, there is an imminent need to grow existing markets and establish new markets for FOGO-derived products. To achieve this, consideration must be given to key market drivers, potential market capacity, and factors influencing each market's willingness to accept and utilise FOGO-derived products.

The Perth and Peel region is uniquely positioned to access end-users, with multiple facilities approved for FOGO processing already widely distributed beyond the metropolitan area. This enables municipal organic waste

[1] Department of Agriculture, Water and the Environment. 2021. Environment Ministers Meeting 1 (www.awe.gov.au)
[2] Waste Authority WA. 2021

transport out of urban areas to recycling facilities in semi-rural or rural settings, improving access to regional markets including extensive agriculture, intensive agriculture, and minesite rehabilitation. It is also feasible to return FOGO-derived products to their metropolitan source for use by residents, businesses and local government in urban amenity and other applications.

1.5 Guiding concepts

In line with the waste hierarchy and the Waste Strategy 2030, FOGO collection is being introduced to recover municipal organic waste, separating organics at source to achieve landfill diversion targets. For FOGO collection to be sustainable, growth of new and existing markets is needed to accommodate FOGO-derived products. It is also important that existing recycled organics markets are not disrupted, distorted, eroded or displaced by FOGO-derived products. The whole supply chain needs to be well understood, appropriately aligned and risks appropriately shared between Councils offering the service and processors manufacturing and selling, such that end-users can beneficially utilise FOGO-derived products in a circular, sustained demand cycle (Figure 2).

»"If the product is free from contamination, you are effectively removing the main barrier to markets!" Brendan Doherty, SMRC«

»It is not just about providing the service it's about doing it right with low contamination to ensure that you close the loop" Lyall Davieson, Cockburn Council«

Figure 2 Overview of the FOGO circular economy supply chain

To establish market demand, developing a framework that engenders success from the outset is critical. Councils must explore strategies to achieve low FOGO feedstock contamination, such that processors can cost-effectively produce FOGO-derived products that meet market expectations. A win-win supply chain balance is considered key to developing and sustaining viable markets for FOGO-derived products in WA.

The aim of this Strategy is to guide market development actions to 2025, targeted to the markets or sectors with the greatest potential to use significant quantities of FOGO-derived products, in alignment with objectives and targets in the Waste Strategy 2030.

The WA Climate Policy commits the Government to working with all sectors of the WA economy to achieve net zero greenhouse gas (GHG) emissions by 2050, and to lead by example, requiring development of net zero emissions transition plans for government agencies and government trading enterprises. This includes a commitment to using State Government purchasing power in procurement of goods and services that will support broader action and outcomes across the community.

Historically, resource recovery has often been driven by a push to divert waste from landfill in line with government strategy targets and the waste hierarchy. The supply of recovered resources has often exceeded the market pull or demand for these secondary products. An imbalance in supply and demand can lead to product stockpiling while markets are developed. This Strategy aims to address that imbalance.

2. Market development opportunity

2.1 Overview of existing and emerging markets

According to the Australian Organics Recycling Association (AORA), the total demand for recycled organic products in WA is currently around 215,000 tonnes per annum. Markets currently using recycled organic products in Australia (including FOGO-derived products and blends), as reported by AORA[3], include:

- **Urban amenity** (52.5%): for use in urban areas including residential and commercial landscaping, retail nursery, special projects (such as road embankments)
- **Intensive agriculture** (26.2%) including viticulture, market gardens, orchards, turf production, nursery production and wholesaling
- **Environmental remediation** (4.1%) contaminated site and soils remediation, water purification and biofiltration uses
- **Rehabilitation** (2.3%) use for landfill cover and rehabilitation, erosion stabilization, land reclamation, restoration, revegetation and rectification[4]
- **Other** (15.0%), including **extensive agriculture** which includes pasture production (livestock including sheep, beef and dairy), broad-acre cropping and forestry.

In WA, although there are few organics processors manufacturing FOGO-derived products, those that are have indicated that the following markets are already purchasing products incorporating FOGO-derived materials:

- Urban amenity via wholesale and retail soil and landscaping supplies yards
- Extensive agriculture (broad-acre cereal and livestock, forestry)
- Intensive agriculture (turf production, vineyards, orchards, market gardens)
- Local Government

Apart from Bunbury Harvey Regional Council currently producing soil conditioners and composts largely derived from FOGO feedstock, other FOGO processors manufacture products blended with suitable ameliorants, in order to meet market expectations.

Based on the range of markets accessed to-date, the following markets are anticipated to become relevant and accessible as availability of supply increases and FOGO processing is more widely distributed:

- Mine rehabilitation projects
- Road/rail development (major projects) for use in rehabilitation of embankments
- Property development (major projects) for use in urban landscaping.

2.2 Key market sectors

Market research revealed five (5) key markets and a selection of sub-markets that currently use recycled organic products or have the necessary drivers and interest to use recycled organic products in the future (Table 1).

Given the relative newness of FOGO in WA, end-users are less familiar with FOGO-derived products, their differentiating qualities, consistency, contamination profile and pricing. GHD has therefore assumed that all markets identified have the potential to use FOGO-derived products or blends, if quality expectations are met.

Markets listed in Table 1 were a focus for targeted consultation. Markets were then ranked through a process of Multi-Criteria Analysis (MCA), outlined in Appendix B.

[3] AORA. 2021. '2030 Vision: Australia's World Leading Organics Recycling Industry of 2030'
[4] Australian Economic Advocacy Solutions. 2020b. Australian Organics Recycling Industry Capacity Assessment.

Table 1 Existing and emerging markets for FOGO-derived products

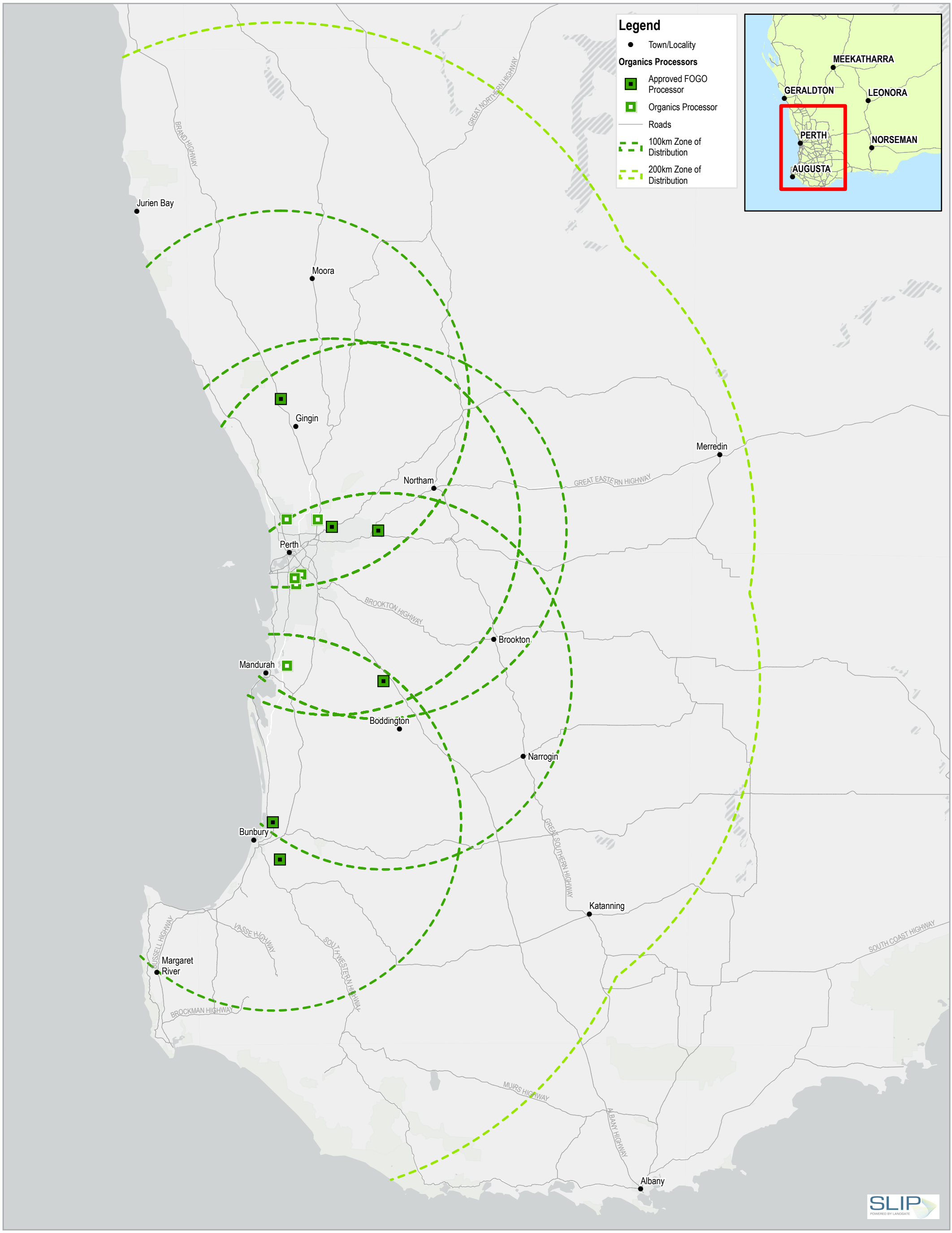
Market	Sub-market	Beneficial use
Urban amenity / landscaping	Local government (parks and gardens)	Garden beds (parks and other) Turf (sports ovals and open spaces in parks and gardens)
	Property development (major projects)	Establishing parks and gardens in new residential developments
	Urban amenity (residential)	Household gardens ('buy back' at waste & recycling centres)
Extensive agriculture	Broad-acre agriculture (cereal and livestock)	Soil amendment
	Forestry	Soil amendment
Intensive agriculture	Grazing	Soil amendment
	Hemp	Soil amendment
	Turf production	Soil amendment
	Vineyard	Soil amendment, weed suppression, pathogen protection
	Orchards (e.g. olive / citrus / avocado)	Soil amendment, weed suppression, pathogen protection
	Market gardens / intensive horticulture (flowers, seedlings, vegetables, fruit)	Soil amendment, weed suppression, pathogen protection
Rehabilitation	Local government	Landscaping – road verges/embankments Landfill cover/reclamation
	Mine rehabilitation	Rehabilitation of disturbed land
	Road development (major projects)	Landscaping – road verges/embankments
	Rail development (major projects)	Landscaping – road verges/embankments
Remediation	Local government	Contaminated sites and soils Water purification/wetlands Biofiltration
	Consultants	

2.3 Review of key market sectors

Existing and emerging markets for FOGO-derived products listed in Table 1 were assessed against ten (10) criteria developed to specifically assess and compare the potential of each market:

1. Competitive advantage of FOGO-derived products in comparison to main competitor
2. Proximity of market to FOGO approved processors (Figure 3)
3. Sensitivity to physical contaminants
4. Sensitivity to chemical contaminants
5. Market size (quantity of use)
6. Market demand (continuity and/or growth in demand)
7. Market interest in using FOGO-derived products
8. Market resistance regarding barriers that could be difficult to overcome
9. Socio-economic benefits from using FOGO-derived products in this market
10. Does this market require amendments to existing policy / standards / certification to support uptake.

Assessments of market perceptions and constraints incorporate input obtained via online surveys and targeted consultation. Where information obtained via survey responses was limited due to a small sample size or lack of participation in engagement processes, the assessment has been informed by desktop research and in-house technical knowledge and judgement.



Paper Size ISO A3

0 10 20 30 40

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

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GHD

Department of Water and Environmental Regulation
Market Development Strategy
for FOGO Derived Products

Project No. **12541803**
Revision No. **A**
Date **24/05/2021**

Product Distribution Potential

FIGURE 3

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Print date: 24 May 2021 - 16:06

Data source: Light Gray Base: Esri, HERE, Garmin, FAO, NOAA, USGS GA: Roads, Town/Locality. GHD: Processors - 20210520, Zone of Distribution - 20210521. Created by: tngavranic

2.3.1 Urban amenity / landscaping

2.3.1.1 Local government (parks and gardens)

Consultation with Local Government suggests that this market is currently using recycled organic products blended to achieve desired quality and consistency. If both quality and consistency can be demonstrated for FOGO-derived products or product blends, it is assumed that Local Governments would use these products.

The value of Local Governments 'buying back' FOGO-derived products extends beyond the potential quantity of use, which is not significantly high compared with other markets explored. Key benefits are derived from achieving circularity or 'closing the loop' around feedstock quality management, with both residents and Local Governments incentivised to share responsibility for minimising contamination, with regular feedstock contamination audits feeding into ongoing community education and messaging.

Strategies such as introducing 'buy back' clauses into waste contracts between councils and processors, and/or mandating targets for Local Governments to procure minimum recycled content, would underwrite annual sales for a proportion of the total FOGO derived products produced, and drive improvements in feedstock quality.

The primary application for local governments using FOGO-derived products (or blends) would likely be in parks and gardens, with subsidiary activities including civil engineering projects incorporating landscaping, rehabilitation and remediation.

Insufficient data was available to assess the potential quantity and regularity of use for rehabilitation and remediation activities, hence the assessment of this market against comparative criteria (Table 2) represents use of FOGO-derived products by council parks and gardens departments only.

Table 2 Market review – local government (parks and gardens)

Criteria	Assessment
Competitive advantage of FOGO-derived products in comparison to main competitor	**Similar price and value** This market is currently using AS4454 soil conditioner, AS3743 soil blend / potting mix, AS4419 landscaping soil, AS4454 compost, and non-certified liquid / solid digestate. Council willingness to pay ranged from 'free' to as much as $60/tonne. This large price range suggests other factors, such as product quality and consistency or circular economy targets, are more important than price.
Proximity of market to FOGO approved processors	50 – 100 km
Sensitivity to physical contaminants	**Very low tolerance** – parks and gardens are public open space
Sensitivity to chemical contaminants	**Very low tolerance** – for persistent herbicides
Market size (quantity of use)	**Medium** (to 2025) 3,500 tpa but may grow significantly if multiple Councils commit to buy-back arrangements. Determining the potential uptake of FOGO-derived product within markets currently using organics and with good record keeping mechanisms, such as Local Government, is relatively reliable. Despite this, the volumes of organics used by individual Local Governments were also not widely shared through the survey, however, a Local Governments that did respond, the favoured products were certified compost or soil conditioner (250 m^3 per annum), followed by certified landscaping soil (50 m^3 per annum) and certified potting mix (10 m^3 per annum). These numbers were used as a proxy to predict potential consumption of FOGO-derived products if all Local Governments within the Perth and Peel region were to 'buy back' the products.
Market demand (continuity and/or growth in demand)	**Medium** Demand, once established, would be predictable with annual demand for products underpinned by sustainable procurement principles.

Criteria	Assessment
	Expected that demand will increase in line with the Waste Strategy 2030 roll out of a consistent three bin kerbside collection system, particularly if 'buy back' clauses, balanced by rise and fall provisions, are included in Council-processor contracts.
Market interest in using FOGO-derived products	**Very interested** Survey results predicted market uptake of 30% in the first five years.
Market resistance regarding barriers that could be difficult to overcome	**High** FOGO-derived products may require blending with other materials to manufacture blends for specific applications (e.g. landscaping soils) with low levels of contamination.
Socio-economic benefits from using FOGO-derived products in this market	**Very high** Local Government 'buy back' promotes circularity and could drive reduced source (FOGO) contamination.
Does this market require amendments to existing policy / standards / certification to support uptake?	**Yes** Amendments to existing policy / standards / certification are required to address contamination concerns.

2.3.1.2 Property development (major projects)

Due to a lack of participation by this market in the online survey, little is known of the product types and volumes being used by this market annually in the context of differentiation between established and familiar products incorporating recycled organics and the emergence of FOGO-derived products. Demand is likely to be discontinuous and highly project specific, however the steady population and development growth observed in WA is an indicator that there would likely be annual demand for recycled organic products for use in urban landscaping in both residential and light commercial developments. If FOGO-derived products can demonstrate similar (or improved) benefits, at a similar (or more competitive) price than recycled organic products currently used, and at an appropriate level of quality, there is expected to be potential for growth in this market.

An assessment of this market against comparative criteria is presented in Table 3.

Table 3 Market review – property development (major projects)

Criteria	Assessment
Competitive advantage of FOGO-derived products in comparison to main competitor	**Slightly more competitive** It is assumed that this market is currently using a range of organic amendments including mulch, soil conditioners, soil blends and compost. Willingness to pay is unknown, however, it is expected that quality managed FOGO-derived products would be of a similar price and value to compost, but slightly more competitive than organic amendments such as mulch and soil blends.
Proximity of market to FOGO approved processors	50 – 100 km Good proximity to processing facilities
Sensitivity to physical contaminants	**Very low tolerance** – residential or light commercial gardens (aesthetics and safety are important)
Sensitivity to chemical contaminants	**Very low tolerance** – for persistent herbicides
Market size (quantity of use)	**Medium** The market size could not be quantified due to a lack of participation by this market in the online survey. However, continual population and development growth observed in WA suggests the market potential could be medium sized.
Market demand (continuity and/or growth in demand)	**Medium** Market has a history of consistent demand for recycled organic soil amendments for urban landscaping. The demand is expected to be medium but consistent and may take time to develop in terms of uptake volume of FOGO-derived products, relative to familiar and

Criteria	Assessment
	already established landscaping soils, blends and soil conditioners incorporating recycled organics products.
Market interest in using FOGO-derived products	**Impartial** The market requires organic amendments – considered essential for improving aesthetics and successfully establishing gardens, but key driver would be cost savings.
Market resistance regarding barriers that could be difficult to overcome	**Impartial** No known resistance towards using FOGO-derived products. However, end products may require blending with other materials to manufacture blends for specific applications (e.g. landscaping soils) with low levels of contamination.
Socio-economic benefits from using FOGO-derived products in this market	**Low** The result of applying FOGO-derived products is mostly improved aesthetics, rather than soil health for the production of food.
Does this market require amendments to existing policy / standards / certification to support uptake?	**Yes** Amendments to existing policy / standards / certification are required to address contamination concerns.

2.3.1.3 Urban amenity (residential)

The Urban Amenity Market could be met by blending into retail products and developing resident by-back schemes within local governments. The circularity created by resident by-back schemes is considered to have advantages by promoting understanding and by-in from the community to reduce contamination.

Issues with persistent herbicides in recycled organic products (incorporating garden organics) have recently received publicity in this market in Victoria, and appropriate management strategies should therefore be considered in the regulatory approach and policy framework supporting market development.

BHRC allows residents to ‘pick up’ compost from the processing facility for a small fee (compared with retail and soil yards) or for free if they have tip passes (provided by their Local Council).

There is considerable cross over with existing recycled organics markets in residential urban amenity, so care is needed to ensure that these markets are not undermined as FOGO processing evolves.

An assessment of this market against comparative criteria is presented in Table 4.

Table 4 Market review – urban amenity (residential)

Criteria	Assessment
Competitive advantage of FOGO-derived products in comparison to main competitor	**Slightly more competitive** Residents were not engaged through the online survey however, product use is expected to be similar to Local Governments and likely includes soil conditioner, soil blends, potting mixes and compost. Resident preference for certified / non-certified products is unknown. Due to the small volumes used by individual residents, price is less likely to present as a barrier to use, if FOGO-derived products are priced similar to other recycled organic products. However, discounts could provide an incentive for residents to ‘trial’ FOGO-derived products.
Proximity of market to FOGO approved processors	50 – 100 km Good proximity to processing facilities
Sensitivity to physical contaminants	**Very low tolerance** – residential gardens (aesthetics and safety are important)
Sensitivity to chemical contaminants	**Very low tolerance** – for persistent herbicides
Market size (quantity of use)	**Medium** Residents were not engaged through the online survey so the market could not be quantified. If incentives were offered for residents to purchase FOGO-derived products, it is estimated this market could be medium sized.

Criteria	Assessment
Market demand (continuity and/or growth in demand)	**Medium** Market has a history of consistent demand for recycled organic soil amendments. The demand is expected to be medium but consistent but may take time to develop in terms of uptake volume.
Market interest in using FOGO-derived products	**Interested** The market is interested in organic amendments (including FOGO-derived products) for landscaping home gardens.
Market resistance regarding barriers that could be difficult to overcome	**Low** FOGO-derived products may require blending with other materials to manufacture blends for specific applications (e.g. landscaping soils).
Socio-economic benefits from using FOGO-derived products in this market	**Very high** Purchase of FOGO-derived products by residents would drive circularity and create 'buy in' from households, with opportunity for greater awareness and a shared sense of responsibility for managing contaminants out of FOGO waste collected from households.
Does this market require amendments to existing policy / standards / certification to support uptake?	**No** Existing policy / standards / certification are suitable for this market, but quality must be appropriate for market specific considerations and expectations.

2.3.2 Extensive agriculture

2.3.2.1 Broad-acre agriculture (cereal and livestock)

Key opportunities for this market include:

- High growth potential and the ability to use large volumes of FOGO-derived products
- Potential to establish annual demand
- Active interest to build soil carbon
- Key drivers include soil degradation challenges, a rapidly changing climate, and opportunities for farmers to source additional revenue by generating Australian Carbon Credit Units, and potentially carbon neutral certification (future driver) for building soil carbon
- Could play an important role in utilising product overflow to avoid stockpiling of FOGO-derived organic materials in the near term, as wider markets are developed
- Adoption of advanced technologies (by processors) to manufacture higher value products better suited to low cost, high efficiency broad-acre application, such as compost pellets or prills delivered via air seeder.

Broad-acre agriculture is sensitive to transport and application costs. Recent NSW trials with pelletised compost, sponsored by the NSW Government, demonstrated significant cost-benefit with pelletised product, which was applied during seeding (single pass). Transport costs were also reduced. Trials with compost pellets have also been undertaken by a commercial operator in WA. Pelletised compost is understood to sell in NSW from around $450 per tonne[5], and in WA, from around $600 per tonne[6] (ex-works).

Economic analysis of the Victorian recycled organics market highlighted the disconnect between market supply, increasing in spring (impacted by storms and holidays) and market demand (relatively uniform).

The ability to quickly move product into the extensive agricultural sector, or to a regionally based composting facility, was seen as a 'relief valve' solution to prevent stockpiling, enabling measured development of smaller volume, higher value niche markets. WA's existing organics processors are generally located on the urban fringe and in rural or semi-rural settings, which improves accessibility and 'reach' beyond the urban source of municipal organics collections. However, there may still be a risk of indefinite stockpiling, particularly with the expected

[5] Pers comm. Virginia Brunton, MRA Consulting, 24 May 2021
[6] Various industry sources; compost pellets and granules are currently manufactured in WA in limited quantities. Prices vary. An example was cited at $675/t (excluding GST) ex-works Perth metro. Delivery extra.

increase in organics tonnages captured via FOGO collection, and a 'relief valve' market focus should therefore be considered in the near term, in line with FOGO roll-out to 2025.

The extensive agriculture (broad-acre) market could be developed into a high volume market, albeit there are demand seasonal constraints and product values may be lower than some other markets in the near term, as farmers develop confidence in the products and cost-benefit knowledge and user experience is gained.

An assessment of this market against comparative criteria is presented in Table 5.

Table 5 Market review – broad-acre agriculture (cereal and livestock)

Criteria	Assessment
Competitive advantage of FOGO-derived products in comparison to main competitor	**Less competitive** than synthetic fertilisers Similar price and value to other organic amendments (e.g. chicken manure) Issues with cost of application
Proximity of market to FOGO approved processors	50 – 100 km
Sensitivity to physical contaminants	**Very low tolerance** for glass (implications for livestock)
Sensitivity to chemical contaminants	**No tolerance** for persistent herbicides (implications for cropping)
Market size (quantity of use)	**Very high** Estimated uptake is 200,000 tpa (assuming quality aligns with market expectations) Geographic information system (GIS) analysis was used to determine the area of land used for cereal cropping and livestock within 100 km of FOGO processors. Survey results estimated that 90% of each property is arable and potentially suitable for FOGO-derived product application. Survey results estimated that a 5% market uptake was likely in the next 5 years. Data from completed agricultural trials was used to estimate the application rate of 10 tonnes per ha with an application frequency of 5 years.
Market demand (continuity and/or growth in demand)	**High** Potential for growth – likely to see gradual uptake as benefits are demonstrated by other farmers The demand of a single farmer is likely to be intermittent with trials suggesting that organics should be applied once every 5 years (further trials and research are required). However, gradual uptake by the market sector is expected to create continuous demand for FOGO-derived products. Farmers are likely to trial applications over a portion of their property and assess the results before applying on a larger scale.
Market interest in using FOGO-derived products	**Very interested** Survey results suggest that up to 85% of broad-acre farmers are likely to be interesting in using organic amendments, such as FOGO-derived products, in the future.
Market resistance regarding barriers that could be difficult to overcome	**High** Resistance rating relates to product quality and consistency – market has no tolerance for persistent herbicides and very low tolerance for glass.
Socio-economic benefits from using FOGO-derived products in this market	**Very high** FOGO-derived products are expected to improve soil health and overall productivity and resilience of crops and pastures. Use of FOGO-derived products in this market may be considered circular, given the product is applied in a cycle that supports the ongoing organics recycling supply chain (food returned to the urban environment where the FOGO originated).
Does this market require amendments to existing policy / standards / certification to support uptake?	**No** Existing policy / standards / certification are acceptable for this market, but quality must be appropriate for market specific considerations and expectations.

2.3.2.2 Forestry

Forestry is not currently using significant volumes of recycled organic products; however, market feedback indicates an interest in using FOGO-derived compost to deliver nutrients over a longer timeframe and increase seedling resilience and survival. It is assumed that applications would be sporadic with recycled organic products applied once, at planting, during a 10 to 25-year plus growth cycle. The Southwest Timber Hub 2021 plan intends to increase the pine plantation estate by at least 50,000 hectares over 5-10 years.

An assessment of this market against comparative criteria is presented in Table 6.

Table 6 Market review – forestry

Criteria	Assessment
Competitive advantage of FOGO-derived products in comparison to main competitor	**Slightly more competitive** – noting significant volumes of recycled organics are not currently used.
Proximity of market to FOGO approved processors	100 – 150 km
Sensitivity to physical contaminants	**Low tolerance** for glass (and possibly plastics) due to limited public access to areas where products would be applied in soil profile reinstatement. Tolerance is slightly less than mine rehabilitation due to the possibility of returning this land to agricultural use in the future.
Sensitivity to chemical contaminants	**Very low tolerance** Forestry stakeholder who participated in the online survey indicated a low tolerance for chemical contaminants, with persistent herbicides presumably being of greatest concern. Environmental stewardship is not a key driver in this market.
Market size (quantity of use)	**Negligible** (to 2025) to **Low** (from 2025) 2,000 tpa GIS analysis was used to determine how much forestry was within 100 km of processors. However, application of product in forestry is likely to be once only, at planting, in the 25-year growth cycle. As such data was sought from the Forest Product Commission website on recent planting rates. In 2019, 2775 ha of plantation forestry was planted. This number was used to estimate annual market size. This data does not indicate distance from processors, so the actual accessible market size is probably much smaller. Application rate was matched to cereal crops as no other data was available.
Market demand (continuity and/or growth in demand)	**Medium** Market demand in this segment is currently low (generally limited to a single application per growth cycle). The WA plantation industry is not currently a significant user of organic soil amendments. Hence demand is uncertain, however there is high potential for market growth.
Market interest in using FOGO-derived products	**Interested** Interested in using FOGO-derived products to deliver nutrients over a longer timeframe (e.g. 3 – 5 years) and improve soil wettability.
Market resistance regarding barriers that could be difficult to overcome	**Low** Quality managed FOGO-derived products are expected to be suitable for this market which has some tolerance for glass and plastic contamination (if low levels and infrequent). There are no regulatory barriers that would need to be overcome before using FOGO-derived products in this market.
Socio-economic benefits from using FOGO-derived products in this market	**Low** FOGO-derived products are applied to improve the survival and growth of trees for the production of timber. Soil health improvements are likely to be shorter-term (i.e. amendments applied at planting only), with limited flow on benefits to local communities.
Does this market require amendments to existing policy / standards / certification to support uptake?	**No** Existing policy / standards / certification are acceptable for this market, but quality must be appropriate for market specific considerations and expectations.

2.3.3 Intensive Agriculture

2.3.3.1 Grazing

Intensive agriculture (grazing) still relies heavily on synthetic fertilizers to deliver nutrients for pasture growth. However, some survey respondents confirmed that organic amendments such as worm juice (bio-dynamic 500) are being trialled, and soil carbon conservation practices are well established. It is known that animal manures, biosolids, compost and some small quantities of pelletised products are also being used some farmers. Nutrient deficiency was the key soil constraint identified.

The market perception is that FOGO-derived products would improve soil structure/quality (including nutrient and moisture retention), improve plant resilience (to drought/disease/ pest), and realise both short and long term cost savings.

Intensive agriculture (grazing) ranked lower in a pre-2025 market attractiveness context for FOGO-derived products due to this market's sensitivity to contaminants; chemical and physical (particularly glass), and biological (pathogens). While FOGO-derived products are becoming more established, and characterisation of properties and performance are progressively demonstrated and communicated, the near-term (pre-2025) market size and potential is considered to be relatively limited.

An assessment of this market against comparative criteria is presented in Table 7.

Table 7 Market review – grazing

Criteria	Assessment
Competitive advantage of FOGO-derived products in comparison to main competitor	**Less competitive** than synthetic fertilisers (price, cost/benefit) Similar price and value to other organic amendments (e.g. chicken manure)
Proximity of market to FOGO approved processors	50 – 100 km
Sensitivity to physical contaminants	**No tolerance** for glass (implications for livestock), limited tolerance for plastics
Sensitivity to chemical contaminants	**No tolerance** for persistent herbicides/pesticides and pathogens (implications for production of pasture and meat for human consumption) Furthermore, international experience with biological pathogens from meat and meat by-products entering the livestock food chain (CJD/BSE) led to regulation excluding meat and meat by-products from recycled organics processing, or a requirement for thermal treatment to inactivate biological contaminants; for example the European Union animal by-products regulations (ABPR).[7]
Market size (quantity of use)	**Medium** 36,000 tpa GIS analysis was used to determine the area of irrigated grazing such, as dairying (from National Maps) within 100 km of FOGO processors. Survey results estimated that 50% of each property is arable and suitable for FOGO product application. Survey results estimated that a 30% market uptake was likely in the next 5 years. Application rate and frequency was matched to cereal crops as no other data was available.
Market demand (continuity and/or growth in demand)	**Low** The demand of a single farmer is likely to be intermittent with trials suggesting that organics should be applied once every 5 years (further trials and research are required). Farmers are likely to trial applications over a portion of their property and assess the results before applying on a larger scale.

[7] European Commission, Food Safety. Accessed from: https://ec.europa.eu/food/food/animal-products_en

Criteria	Assessment
Market interest in using FOGO-derived products	**Impartial** Survey results indicate this market is interested in using organic amendments, such as FOGO-derived products, as a complimentary practise to reduce synthetic fertilizer and improve overall soil health.
Market resistance regarding barriers that could be difficult to overcome	**High** Resistance rating relates to product quality and consistency – market has no tolerance for persistent herbicides and very low tolerance for glass.
Socio-economic benefits from using FOGO-derived products in this market	**Low** Intensive grazing occurs on higher quality soils in the south-west of WA, which are in less need of remediation. Climate is favourable to soil carbon accumulation (compared to dryer areas of the WA Wheatbelt).
Does this market require amendments to existing policy / standards / certification to support uptake?	**Yes** Amendments to existing policy / standards / certification are required to address contamination concerns.

2.3.3.2 Hemp

Hemp is included here since a WA hemp grower completed the online survey and expressed keen interest in use of FOGO-derived products. Hemp is still an immature and developing industry in WA and potential market demand could not be quantified. The area of land currently used for growing hemp is also unknown.

Recycled organic products currently used by this market include soil conditioner, pellets and animal manure.

Soil quality challenges reported by the survey respondent included:

- Non-wetting soils
- Excess surface water runoff
- Nutrient deficiencies
- Low organic matter.

The general market perception is that FOGO-derived products would improve soil structure/quality (including nutrient and water retention) and improve soil biology. Application rates are expected to be similar to broad-acre agriculture, in the order of 10 tonnes/hectare applied once in a 5-year period. The survey respondent indicated a willingness to pay $10 – 20 per tonne of product.

The survey respondent indicated a general intolerance for both physical and chemical contaminants. Due to the absence of livestock and the lack of public interaction with amended areas, there may be some tolerance for glass contamination if the levels were low, but this would need to be confirmed.

2.3.3.3 Turf production

Turf production is an intensive process which requires the application of soil amendments to produce healthy turf over a short timeframe. Hence, there is potential for FOGO-derived products to be used by this market, however, the market potential and perceptions could not be determined due to the lack of engagement.

Soil quality challenges faced by turf producers are likely to include:

- Nutrient deficiencies
- Water logging
- Non-wetting soils.

This market is expected to be highly sensitive to physical contaminants (e.g. glass) and chemical contaminants (e.g. persistent herbicides). Recycled organic products have a place in this market, but these products must be of a consistent high quality with no contamination. Bunbury Harvey Regional Council advised of successful sale of

FOGO-derived products into this market, so further investigation of this potential market may be warranted in the medium term (for growth beyond 2025).

2.3.3.4 Vineyard / viticulture

There is potential for FOGO-derived products to be used by this market, however, the market potential could not be estimated due to the lack of engagement/response during the consultation process.

It is possible that interest for FOGO-derived products may mirror that of olive growers (refer to Section 2.3.3.5). Insights from peak body, Olives WA, may provide an indication of product types and certification/regulation this market is looking for to trust and use FOGO-derived products, but this would need confirming via further engagement. Bunbury Harvey Regional Council advised of successful sale of FOGO-derived products into this market, so further investigation of this potential market may be warranted in the longer term (for growth beyond 2025).

2.3.3.5 Orchards and tree crops (e.g. olive / citrus / avocado)

This market is currently using recycled organic products (primarily mulch), a portion of which could be substituted with or supplemented by FOGO-derived products to deliver a higher nutritional profile to the tree crop.

BHRC have confirmed the sale of FOGO-derived products to avocado growers. Orchards with high value produce, such as avocado, are more likely to have suitable profit margins to afford to incorporate FOGO-derived compost in their production regimes, assuming the product is of consistent quality and free of contaminants.

Intensive agriculture (orchards) ranked lower in a pre-2025 context due to the sensitivity of this market to chemical and biological contaminants (e.g. dieback), and the limited market size while FOGO-derived products become more established, and characterisation of properties and performance is still in progress. Bunbury Harvey Regional Council advised of successful sale of FOGO-derived products into this market, so further investigation of this potential market may be warranted in the longer term (for growth beyond 2025).

An assessment of this market against comparative criteria is presented in Table 8.

Table 8 Market review – orchards

Criteria	Assessment
Competitive advantage of FOGO-derived products in comparison to main competitor	**Slightly more competitive** Tree crop farmers, in particular those looking to transition towards organic certification, understand the value that FOGO-derived products can offer. Many are seeking organic amendments to use in place of synthetic fertilizers (pers comm. Steve Milton – Olives WA). The primary competing product is mulch, a cheaper alternative, which is used for controlling weeds, protecting against disease, retaining soil moisture, and reducing soil erosion (as a surface soil amendment). Growers understand that FOGO-derived products can deliver nutrients in combination with these other treatments. It is expected that FOGO-derived products would be used in combination with mulch, to reduce synthetic fertilizer use and improve water use efficiency.
Proximity of market to FOGO approved processors	100 – 150 km
Sensitivity to physical contaminants	**Low tolerance** This market is likely to be more tolerant to physical contaminants (e.g. plastics, glass) compared with intensive or extensive agriculture for livestock production (pers comm. Patrick Page - DPIRD).
Sensitivity to chemical contaminants	**Very low tolerance** This market is highly sensitive to chemical contaminants and heavy metals due to the requirement for produce to be tested for contaminates prior to local use or export (pers comm. Patrick Page - DPIRD). Furthermore, growers seeking organic certification would have virtually no tolerance for chemical contaminants.
Market size (quantity of use)	**Low** 1,000 tpa GIS analysis was used to determine the area of orchards within 100 km of FOGO processors. Data from National Maps for areas of irrigated citrus, irrigated fruit trees,

Criteria	Assessment
	irrigated olives, irrigated tree nuts and olives was used. Survey results estimated that 100% of each property is arable and suitable for FOGO product application. Survey results estimated that a 5% market uptake was likely in the next 5 years. Application rate and frequency was matched to cereal crops as no other data was available.
Market demand (continuity and/or growth in demand)	**High** Potential for growth – market is currently using recycled organic products, a portion of which could be substituted with FOGO-derived products. Likely to see gradual uptake as benefits are demonstrated by other growers. The demand of a single grower may be intermittent (i.e. once every 5 years). However, gradual uptake by the market sector is expected to create continuous demand (on an annual basis) for FOGO-derived products.
Market interest in using FOGO-derived products	**Interested** Market is interested in applying FOGO-derived products to: - Reduce quantity of synthetic fertilizers applied (or number/regularity of applications) - Improve soil structure/quality (including nutrient and water retention) - Improve plant resilience (to drought/disease/ pest). Those seeking organic certification are particularly interested.
Market resistance regarding barriers that could be difficult to overcome	**Impartial** No notable resistance except for a general intolerance for chemical contamination and heavy metals, the traces of which could end up in produce which is tested.
Socio-economic benefits from using FOGO-derived products in this market	**Medium** FOGO-derived products are expected to improve soil health and overall productivity and resilience of tree crops. Compared with extensive agriculture, the benefits are similar, but the scale and extent of land degradation is comparatively less.
Does this market require amendments to existing policy / standards / certification to support uptake?	**Yes** Amendments to existing policy / standards / certification are required to address contamination concerns.

2.3.3.6 Market gardens / intensive horticulture (flowers, seedlings, vegetables, fruit)

Consultation with Department of Primary Industries and Regional Development (DPIRD) via interview indicated that the market garden / intensive horticulture sector is a more fragile market (with respect to contamination), is expected to have a lower uptake (5-10% interested), and to use much smaller quantities of product than other agricultural enterprises. The sensitivity to chemical contamination is largely around persistent herbicides (potentially damaging planted crops and produce) and also concerns that chemicals may be more easily transferred to the edible portion (fruit/seed/leaf) in leafy green vegetables and fruits, compared with grains produced in extensive agriculture.

Food produce is tested both for local use and export, hence there is no tolerance for chemical or heavy metal contamination. Furthermore, this market would seek demonstration of not just the product performance, but how this product can be used with other products and practices to achieve reliable yields and the best commercial and market-specific outcome. There would need to be substantial investment in trials and field days to reach this market and achieve significant uptake of FOGO-derived products, and potential returns for FOGO recyclers (Councils and processors) may not justify the investment likely to be required.

The market potential could not be sized due to the lack of engagement.

2.3.4 Rehabilitation

2.3.4.1 Local government

Refer to section 2.3.1.1.

2.3.4.2 Mine rehabilitation

Key opportunities for this market include:

- High growth potential
- Multiple mines located within 100 km of the Perth and Peel region (Figure 4). Where the resource extraction method requires strip-mining (i.e. mineral sands) or removal of the overburden only (i.e. bauxite mining), the disturbance footprint is larger and hence there is a greater requirement to undertake progressive rehabilitation
- The ability to use medium volumes of FOGO-derived products (albeit demand is likely to be discontinuous and highly project specific)
- Moderate tolerance for glass (and possibly plastics) due to limited public access to areas where products would be applied in soil profile reinstatement.
- Best practise for rehabilitation is underpinned by clear regulatory guidance.

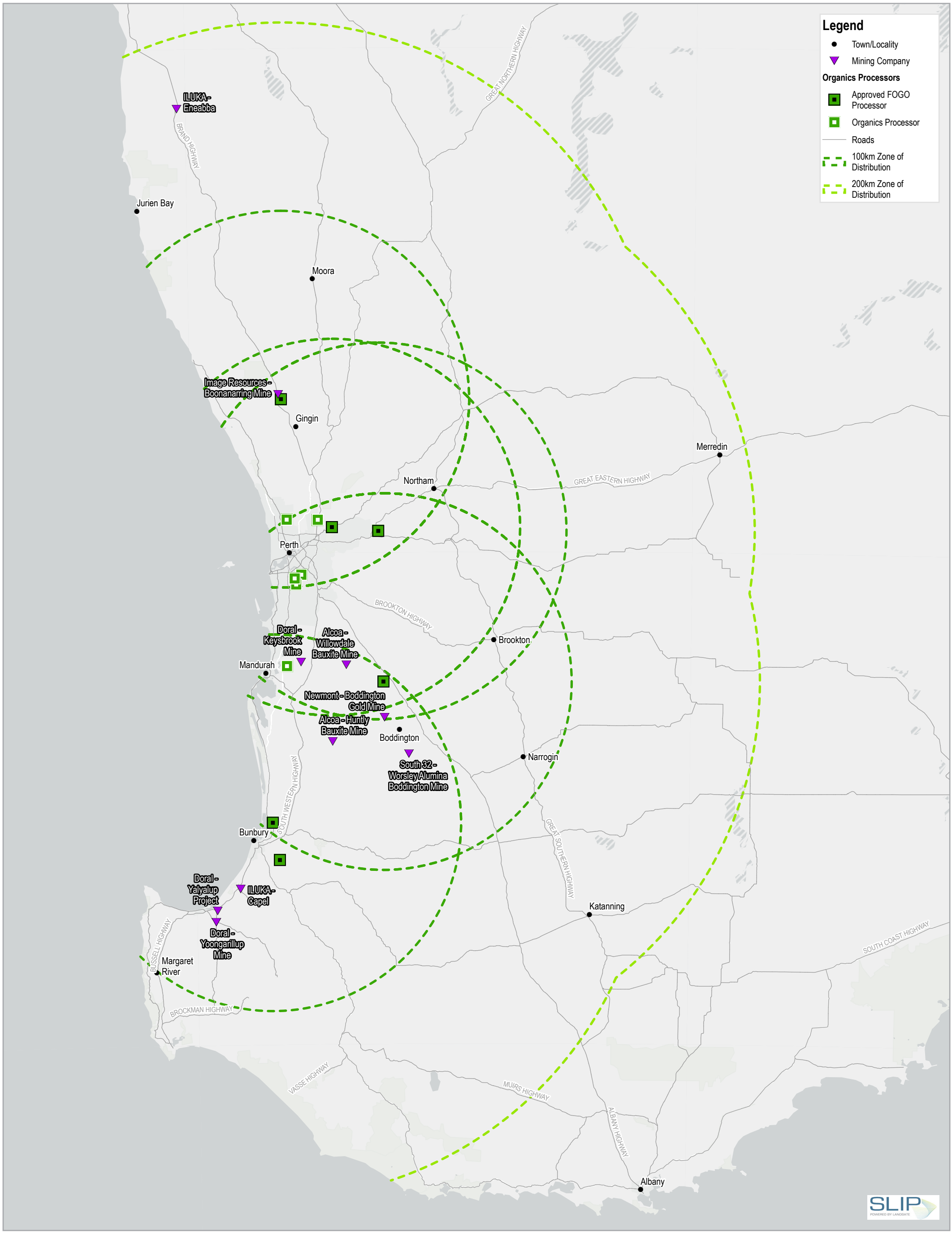
An assessment of this market against comparative criteria is presented in Table 9.

Table 9 Market review – mine rehabilitation

Criteria	Assessment
Competitive advantage of FOGO-derived products in comparison to main competitor	**Slightly more competitive** Subject to proximity of production to end use location, rehabilitation objectives and availability of product in sufficient quantities at the appropriate time, there may be scope for FOGO-derived products to find a niche in this market.
Proximity of market to FOGO approved processors	50 – 100 km (Figure 4)
Sensitivity to physical contaminants	**Moderate tolerance** for glass (and possibly plastics) due to limited public access to areas where products would be applied in soil profile reinstatement.
Sensitivity to chemical contaminants	**Very low tolerance** Market is aware of their environmental stewardship and is committed to avoiding and minimising impacts where practicable. This applies particularly to any contaminants that could be transported offsite (via mobilisation to groundwater or surface water receptors).
Market size (quantity of use)	**Medium** No data was available to quantify market size
Market demand (continuity and/or growth in demand)	**High** Potential for growth – likely to see gradual uptake as benefits are demonstrated. Demand at a single mine site is likely to be discontinuous and highly project specific. However, where the resource extraction method requires strip-mining (i.e. mineral sands) or removal of the overburden only (i.e. bauxite mining), the disturbance footprint is larger and hence there is a greater requirement to undertake progressive rehabilitation. There are a number of mineral and resource companies with mines located on the Swan Coastal Plain and Darling Scarp including Doral Mineral Sands, ILUKA, Image Resources and Alcoa.
Market interest in using FOGO-derived products	**Very interested** Survey results suggest that up to 75% of mine site rehabilitation projects on the Swan Coastal Plain and Darling Scarp are likely to be interesting in using organic amendments, such as FOGO-derived products, in the future.

Criteria	Assessment
Market resistance regarding barriers that could be difficult to overcome	**Low** Aside from approvals constraints, and lack of familiarity with products, the potential for significant volumes of FOGO-derived products to be used in this market is considered medium. Balancing timely supply with project-based demand may be challenging in the near term.
Socio-economic benefits from using FOGO-derived products in this market	**Very high** Although use of FOGO-derived products in this market may be considered linear rather than circular, given the product is applied as a once-off application that leaves the organics recycling supply chain (not returning to the urban environment where the FOGO originated), recycling organics avoids landfill disposal (reducing emissions), and when recycled organic products are applied to damaged soils, this supports re-growth of native vegetation which delivers ecological benefits whilst also sequestering carbon.
Does this market require amendments to existing policy / standards / certification to support uptake?	**Yes** Amendments to existing policy / standards / certification are required to address chemical contamination concerns.

Figure 4 depicts surface mining operations located generally within a 100 km radius of relevant existing approved organics recycling facilities servicing the Perth and Peel, as well as the Bunbury Harvey regions, noting this is does not include all organics recycling facilities in the region. It is noted that the Iluka Resources mineral sands mining operation at Eneabba is around 150 km north of the nearest organics recycling facility considered relevant at the time of development of this Strategy.



Paper Size ISO A3

0 10 20 30 40

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

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GHD

Department of Water and Environmental Regulation
Market Development Strategy
for FOGO Derived Products

Mines located within 100 km of FOGO approved processors

Project No. **12541803**
Revision No. **A**
Date **24/05/2021**

FIGURE 4

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Print date: 24 May 2021 - 16:07

Data source: Light Gray Base: Esri, HERE, Garmin, FAO, NOAA, USGS GA: Roads, Town/Locality. ABARES: Agricultural Industries - 2018. GHD: Processors and Mines - 20210520, Zone of Distribution - 20210521. Created by: tngavranic

2.3.4.3 Road and rail development (major projects)

Major road and rail projects were identified as potential markets for FOGO-derived products. It is noted that the State Government has made high level commitments to using recycled content in major projects and it is therefore anticipated that, over time, there may be potential for use of significant quantities of recycled organic products that may also include FOGO-derived materials.

Demand is expected to be intermittent, given the generally discontinuous nature of major road and rail projects. The market potential and size could not be estimated due to lack of engagement and limited precedent. It was noted that the uptake of recycled aggregates in major road and rail projects, which in many ways could be considered analogous to use of recycled organics, has been very low to-date, despite several years of facilitation and market development.

An assessment of this market against comparative criteria is presented in Table 10.

Table 10 Market review – road development (major projects)

Criteria	Assessment
Competitive advantage of FOGO-derived products in comparison to main competitor	**Similar price and value** This market is currently using mulch (derived from in situ chipping of cleared vegetation), augmented by soil blends or conditioners as required. Site-generated mulch is a relatively low-cost product with low contaminant/disease risk, but FOGO-derived products would offer superior nutrient delivery and may contribute overall soil health improvements. Hence there is likely to be movement to tailor the price to product value.
Proximity of market to FOGO approved processors	**50 – 150 km** Major Road Development Projects are expected to be within proximity (50 – 150 km) of organics processors, however, due to the arterial nature of linear infrastructure projects, transport distance could increase to access all parts of a project. There may be a need for strategic stockpiling of committed product to service project-based demand to enable project schedule alignment.
Sensitivity to physical contaminants	**Moderate tolerance** for glass (and possibly plastics) due to limited public access to areas where products would be applied in soil profile reinstatement (subject to relevant approvals).
Sensitivity to chemical contaminants	**Moderate tolerance** for most chemical contaminants that will not compromise plant survival and growth. This market has existing measures to manage runoff from roads which is expected to contain contaminants (hydrocarbons being one of the primary contaminants).
Market size (quantity of use)	**Low** pre-2025 to **Medium** post-2025 No information was presented via survey responses to allow the market size to be quantified. Quantifying potential use would require further consultation with Main Roads WA to understand their average annual use of imported organics (excluding mulch), and procurement specification requirements and project-specific constraints. This market is likely to have potential to use large volumes, relative to Local Government, subject to commitments to procuring recycled organic materials and incorporating them into project procurement and execution planning early in the project life cycle.
Market demand (continuity and/or growth in demand)	**Medium** This market is currently using mulch (the majority derived from in-situ mulching) and imported soil conditioner. Hence there is potential for growth in this market, particularly if State Government were to mandate targets for State Government Departments and Local Governments to procure minimum recycled content. Demand is expected to remain highly project-specific and therefore intermittent.
Market interest in using FOGO-derived products	**Very interested** This market is understood to be highly motivated to explore the use of recycled products due to State Government commitments and associated sustainable procurement action plans.
Market resistance regarding barriers that could be difficult to overcome	**Low**

Criteria	Assessment
	Aside from approvals constraints, and lack of familiarity with products, the potential for significant volumes of FOGO-derived products to be used in this market is considered high in the medium to long term. Balancing timely supply with project-based demand may be challenging in the near term.
Socio-economic benefits from using FOGO-derived products in this market	**Low** Use of FOGO-derived materials in this market segment may be considered more linear than circular in that the product would be applied as a one-off application in potentially sensitive environments, and the organics exit the recycling supply chain (not returned via food or other agricultural produce consumption in the urban environment where the FOGO originated).
Does this market require amendments to existing policy / standards / certification to support uptake?	**Yes** New policy / standards / certification required to manage ecological considerations associated with introducing exogenous materials relative to use of site-generated materials (only).

2.3.5 Remediation

There is potential for FOGO-derived products to be used in this market. Market research shows that FOGO-derived products can be useful in remediation activities. Phone consultation with two remediation consultants suggested there was an interest in FOGO-derived products and how these could be used in remediation activities, however, neither consultant completed the online survey.

Requirements are likely to be project-specific and require consideration of relevant approvals including assessment of environmental receptors.

Demand is expected to be intermittent, given the generally discontinuous nature of remediation projects. The market potential could not be estimated due to the lack of engagement.

Although use of FOGO-derived products in this market may be considered linear rather than circular, given the product is applied as a one-off application that leaves the organics recycling supply chain (not returning to the urban environment where the FOGO originated), recycling organics avoids landfill disposal (reducing emissions), and when recycled organic products are applied to damaged soils, this supports re-establishment of vegetation which delivers ecological benefits whilst also sequestering carbon.

2.4 Market ranking

A process of Multi-Criteria Analysis (MCA) was used to identify the most promising market segments for FOGO derived products, with priority focus on markets with capacity to accept significant volumes in the near term (to 2025), allowing parallel development of niche and higher value markets for a broader range of products, over time.

Potential markets for FOGO-derived products were ranked according to the criteria presented in Section 2.3. Criteria were weighted for importance, with the highest weightings given to:

- Sensitivity to chemical contaminants (in the nominated market)
- Specifications, regulatory standards and policy barriers
- Proximity (i.e. location)
- Market size (quantity of use).

Information was gathered via stakeholder consultation processes to inform the MCA. Stakeholders were consulted via comprehensive online survey and subsequent interviews. There were 54 surveys completed, however, the response rate in some sub-market segments was low (only 1 or 2 responses).

The market ranking results are presented in Table 11.

Table 11 Market ranking

Rank	Market
1	Extensive agriculture (cereal and livestock)
2	Mine rehabilitation
3	Urban amenity (residential)
4	Extensive agriculture (forestry)
5	Road development (major projects)
6	Local Government (parks and gardens)
7	Intensive agriculture (orchards)
8	Intensive agriculture (grazing)

Key barriers shared by the top-ranked markets is presented in Table 12 . The derived actions presented in Appendix C (Actions).

Table 13 presents a theoretical market value to understand the opportunity available if barriers are addressed.

Table 12 Key barriers to use of FOGO-derived products in the identified target markets

	Extensive agriculture (cereal and livestock)	Mine rehabilitation	Urban amenity (residential)	Extensive agriculture (forestry)	Road development (major projects)	Local Government (parks and gardens)	Intensive agriculture (orchards)	Intensive agriculture (grazing)
Sensitive to Physical contaminants	✓	✓	✓	✓	✓	✓	✓	✓
Sensitive to chemical contaminants	✓	✓	✓	✓	✓	✓	✓	✓
Sensitive to biological contaminants								✓
New market that requires exploration		✓		✓	✓			
Developing market that requires support	✓						✓	✓
Existing organics market sensitive to competition			✓			✓		
Product development required	✓							
Sporadic project-based use		✓		✓	✓			

Table 13 Theoretical market value

	Extensive agriculture (cereal and livestock)	Mine rehabilitation	Urban amenity (residential)	Extensive agriculture (forestry)	Road development (major projects)	Local Government (parks and gardens)	Intensive agriculture (orchards)	Intensive agriculture (grazing)
Estimated size of market (tpa) to 2025	200,000 (145,000 used in calculation)	unknown	unknown	2,000	unknown	3,500	1,000	36,000
Potential price point for market	$0.50 - $20	unknown	unknown	$10 - $20	$10 - $20	$0 - $60	$5 - $10	$10 - $20
*Hypothetical Annual Value	$1,486,250	unknown	unknown	$30,000	unknown	$105,000	$7,500	$540,000
*Subject to the limitations described in Appendix B.								

2.5 Market value estimation

Although the stakeholder consultation and market identification processes undertaken in support of developing this Strategy sought to gauge market awareness, perceptions, barriers and opportunities for FOGO-derived products, the objective was not to undertake a market study. In that context, it was not possible to confidently estimate the market value of FOGO-derived products in a very immature and undeveloped market. However, based on responses from the online survey and targeted consultation, a number of price indications were obtained through querying what potential end users would be willing to pay in various markets. The “acceptable” price indications ranged from nil cost, to $20 per tonne, and some potential users indicated they would be willing to pay up to $60 per tonne for a product of appropriate quality. When product transport or delivery costs are factored in and blending or amendment with other materials increase overall tonnages of FOGO-derived products, the range of values and associated variables become quite considerable. The cost of blending and amendments also adds complexity.

Therefore, it is possibly more useful to derive a nominal hypothetical total market value for all FOGO-derived materials (the organic component of any FOGO-derived products) to be generated from FOGO collected in the Perth and Peel regions. Based on the expectation that all Perth and Peel councils will implement FOGO by 2025, the quantity of FOGO waste collected is expected to be around 410,000 tonnes per annum[8]. As noted in Section 1.4, the quantity of FOGO-derived materials produced from FOGO processing is projected to be in the order of 145,000 tonnes per annum by 2025.

If we simply assume that all FOGO-derived materials are sold in 2025, and sale values range from $0 to $60 per tonne, the potential total annual sales generated, and the corresponding potential offset to processing costs at those product sale values, expressed as a rate per tonne of FOGO waste collected, are presented in Table 14 below.

Table 14 Relative value of FOGO-derived materials vs FOGO waste input tonnage

	FOGO-derived materials (145,000 tpa) - total value ($/annum)	FOGO waste collected (410,000 tpa) - offset value ($/tonne)
Assumed sale price $0/tonne	0	0
Assumed sale price $20/tonne	2,900,000	7.07
Assumed sale price $60/tonne	8,700,000	21.20

It is important that the initial market development actions target markets able to utilise the largest volumes of FOGO-derived products, or markets that will use products consistently and reliably, to avoid stockpiling of products and support market development and growth. Figure 5 presents a strategic approach for developing the three highest ranking markets.

[8] Waste Authority WA. 2021

Figure 5 Strategic approach for developing the three highest ranking markets

3. Market case studies

This Strategy applies learnings from the latest research and success stories both nationally and internationally, to outline key considerations for building a consistent market base for FOGO-derived products in WA. Presented in Table 15 are key learnings from trials undertaken with recycled organic products in the three top-ranked market segments.

Table 15 Key learning from trials with FOGO-derived compost

Market	Overview	Benefits observed	Key learnings
Extensive agriculture (cereal and livestock)	NSW trial by MRA Consulting Group9 testing pelletised compost applied with an airseeder. Funding from the NSW Environment Protection Authority's (EPA) Organics Market Development program allowed the establishment of the pelletised compost trial. The aim of this trial was to demonstrate the cost and yield benefits of direct application of pelletised compost by an airseeder. Compost was manufactured from a combination of commercial food organics (FO) and garden organics (GO)	>50% increase in yield Neutralised pH Increased cation exchange capacity Increased microbial activity More expensive to purchase ($450/t)[10] but cheaper overall ($45/ha) due to lower rate of application (10t/ha) and no additional costs to apply **Result:** *pelletised compost increased crop yield and profitability by approximately $1,000/ha*	Pelletised compost overcomes the cost barrier associated with applying organics at scale (time, labour, and specialised equipment) The pellet can be applied during seeding, with the added benefit of incorporating compost into the soil profile delivering greater nutritional and other benefits to the seed and soil Pelletised compost is cheaper overall for the farmer (applied cost of $45/ha compared with $450/ha for loose compost), and therefore could be charged at a higher price Local commercial trials of pelletised product in WA (by others) are also showing encouraging results.

[9] MRA Consulting Group. 2021. Compost Pellets Down the Tube
[10] Pers comm. Virginia Brunton, MRA Consulting, 24 April 2021

Market	Overview	Benefits observed	Key learnings
Mine rehabilitation	The UK Waste and Resources Action Programme (WRAP) shares a number of UK based case studies highlighting successful rehabilitation of mine sites using compost, including FO and GO-derived composts. Two of the brownfield sites were suitably rehabilitated for growing biofuel crops for the production of renewable energy. Soils were reported to be nutrient deficient, acidic, and prone to waterlogging	Reported benefits included: - Increased organic matter - Increased potassium - Increased phosphorus - Increased magnesium - Increased pH - Increased plant available water - Discourage invasive weed species In all cases the benefits were observed for the duration of trials (3/4 years). Compost application was reported to be a cost-effective method of increasing plant productivity (yields).	Compost was applied at much higher rates (300 – 600 t/ha). Nutrients were found to be slow release, allowing for a 'once off' application Compost was applied using a spreader and then incorporated into the soil profile
Roadside rehabilitation	Case studies reported by WRAP and also by NSW EPA provide insights into the value of using compost in roadside rehabilitation activities to control erosion	Reported benefits included: - Effective erosion control - Increased soil moisture retention Benefits were observed for the duration of trials (3 years).	Compost can be applied at the surface (compost mat), or to a mesh underlay (compost sock) Compost particle size influences effectiveness Aged compost improves the humus layer formed for more effective erosion control Aged compost is better at collecting/binding impurities from contaminated surface water runoff from sealed roads
Industrial remediation	WRAP shares a UK based case study highlighting successful rehabilitation of a former chemical processing facility using compost to establish shallow rooted native vegetation	Vegetation was successfully established in the medium and the aesthetics of the site greatly improved. The solution was highly cost effective (approximately 25% of the cost of importing topsoil), due to the smaller volumes of compost required to achieve the same outcome.	Compost can be applied with rubble, directly on top of solid concrete, and shallow rooted vegetation successfully established.

4. Market barriers and key strategies

4.1 Barriers and opportunities identified from market research

4.1.1 Overview of barriers

Market research has identified the following key barriers:

Regulatory barriers (policy/standards)

- Lack of policy framework to ensure Councils introduce FOGO collection services that produce feedstock with low contamination
- Australian Standard AS4454 'Composts, soil conditioners and mulches' does not incorporate the whole supply chain and only defines a minimum product standard
- More specific product standards are needed to meet market expectations. Allowable physical and chemical contaminant levels also need reviewing
- Lack of clarity around regulatory and policy settings for organics recycling facilities and quality management requirements; draft Guideline 'Better practice Composting' still not finalised after many years in development
- Lack of policy framework and standards for use of solid and liquid digestate (from anaerobic digestion) as organic fertiliser (low solids digestate generally treated as controlled waste in most states, including WA)
- Current testing regimes are not strict enough for end users to trust product quality, and concerns raised over potential future liability for possible contaminants in recycled organics products (e.g. microplastics, PFAS).

Insufficient organics recycling infrastructure in WA

- Waste infrastructure capacity not yet sufficiently developed to absorb the FOGO volumes projected to be collected
- Current facilities may not meet revised standards in time and may require additional investment in upgrades, with lack of clarity around compliance requirements. May be locked into contracts at set gate fees
- It is expensive to upgrade existing processes to deal with contaminants in FOGO feedstock and investment in new or upgraded infrastructure is commercial risk in the absence of clear policy and regulatory framework
- Additional processing of FOGO-derived materials may make end products too expensive to sell relative to gate fees available and competition from products derived from other organic waste inputs.

Perception that FOGO-derived products may be of low quality, including contaminants, resulting in low market interest/demand

- Insufficient trials (to-date) to demonstrate cost and other benefits of FOGO-derived products to WA markets
- Processing cost vs proximity to end markets is an important consideration (including transport costs)
- Concerns that financial incentives/support and/or stockpiling may be needed to help industry manage transitionary challenges.

4.1.2 Transport cost

Transport is a key factor in accessing regional agricultural markets, and the movement of product back to metropolitan markets from processing facilities and the cost of transport can be a significant challenge to be overcome.

Transport costs can vary significantly depending on a range of payload-influencing variables including bulk density, vehicle configuration, travel distance and time, as well as route restrictions. Commercial variables also include casual vs long-term contract rate efficiencies, availability and proximity of the transport contractor to either origin or destination.

4.1.3 Opportunities (success factors)

Strategies to address the barriers and concerns outlined in Section 4.1, can be found by assessing key success factors and learnings in other countries and jurisdictions where a successful circular economy has been established around organics recycling:

- Regulating end products through certifications/standards that are applied across the whole supply chain, including feedstock. This produces end products that the end markets trust and understand.
- Success follows investment in advanced collection methods and/or ongoing intervention (education and contamination monitoring) to achieve low contamination levels and produce high-quality products.
- Circular targets that also focus on application of end products (i.e. bringing nutrition back to soils).
- Input streams are managed to be as clean and free of contaminants as possible (source separation).
- Community education and consistency of messaging are informed by regular monitoring (audits) of FOGO collection material to reinforce positive behaviour, fostering engagement and alignment of interests.
- In conjunction with ongoing community education and feedstock contaminant reduction, composting processes incorporate pre-sorting and product refining systems to manage contaminants in products.
- Anaerobic digestion is incorporated into the processing technology suite in many countries and integrated with aerobic composting processes to produce products with high market acceptance and demand.
- Trials and case studies are presented to inform end users around how to get the most value from products.
- FOGO-derived products are quality managed to defined standards and directed to appropriate markets.

4.2 Barriers and opportunities raised by stakeholders

4.2.1 Overview of barriers

Peak bodies (organic recycling), national and state government identified the following as key barriers for the development of markets for FOGO-derived products in WA:

- Local governments are unable to control feedstock contamination, preventing processors from cost-effectively producing consistently high-quality products
- Unclear market strategy/policy targets on preferred uptake from State Government
- Concern over damage to plants or crops from chemical contaminants
- Lack of knowledge around benefits of using FOGO-derived products (unfamiliar with product)
- Inconsistent product quality
- High cost of incorporating or applying FOGO-derived products
- Perception that FOGO-derived product might be too expensive (with transport cost on top)

Processor concerns relating to the production of FOGO-derived products were similar:

- Contaminated or low-quality feedstock will impact product quality and market acceptance
- A lack of clearly articulated market strategy and policy targets leading to costs of production that are too high in comparison with product value (insufficient value-add relative to input costs in processing).

Some markets consulted through the online survey, such as the agricultural sectors, showed a strong interest in using FOGO-derived products, despite some respondents having no previous experience using recycled organic products. Across all markets, there was a general lack of familiarity with FOGO-derived products as distinct from other, more familiar recycled organic products. The general perception was that FOGO-derived products might be ‘too contaminated and too expensive’. It is important to note that FOGO collection and processing in WA is still very new and there is limited market awareness around the types of products that can be manufactured with FOGO-derived materials, and the benefits (both economic and other) of applying these to soils. This highlights the importance of characterising FOGO-derived products and communicating the benefits of quality managed recycled organic products (including those containing FOGO), to WA markets.

4.2.2 Suggested actions and strategies

Actions and strategies selected in survey responses by end markets, government, processors and peak bodies included:

- Quality assurance to an appropriate Australian Standard
- Market specific specifications/standards/certifications
- Incentives to purchasers such as subsidies and discounts to develop market interest and trust
- Funding trials to demonstrate cost (and other) benefits
- Funding education campaigns on benefits (and for LGs on how to correctly use bins).

4.2.3 Contamination of FOGO-derived products

When discussing contaminants in the FOGO stream it is important to understand the differences and potential sources of those that derive from the FO component and those associated with GO, which are therefore not unique to FOGO.

Selective herbicides have become more important for the control of grass weeds, and some selective broad-leaf weed killing herbicides contain active constituents that are not degraded through composting. Several new biodegradable herbicides have recently been released for domestic lawn grass weed control, with consumers becoming more aware of the environmental implications of certain active ingredients.

In the household FO stream, common contaminants are packaging around spoiled food, and takeaway containers.

Contaminants found in FOGO waste collected from households, some of which are incorrectly placed in FOGO bins, and others being incidental contaminants, are:

- Glass (bottles and jars)
- Plastics (non-compostable bags, shrink wrap, packaging, single use plastic items, plastic coated paper items)
- Metal items (beverage containers, food tins, lids off bottles and jars)
- Herbicides and herbicide residues (from contaminated grass clippings, weeds)
- Treated wood (off-cuts, shavings, sawdust from preservative treated and engineered timbers)
- Heavy metals (dry cell batteries, treated timbers)
- Diseased and/or pest affected garden waste (e.g. pathogens)

The characteristics of all recycled organic products, including FOGO-derived products, need to be considered in the context of their intended end market. This is usually managed by the processor when manufacturing particular blends or products for specific applications, however, risks also need to be evaluated by end users before applying them on land.

The types of contaminants in organics recycling feedstocks fall into three broad categories, being: physical chemical and biological. The extent to which contaminants are a concern in recycled organics products is generally a function of the source of the feedstocks, the level of contaminants in the feedstocks, the processing to which the material is subjected, quality management and testing protocols, and the target market for the product/s.

Although there have been examples of certain physical and chemical contaminants of concern being present in recycled organic products, further work may be needed to characterise the extent to which these contaminants may impact the suitability of FOGO-derived products for their intended markets.

Detailed assessment of specific contaminants, product characterisation, risk assessment and mitigation strategies were beyond the scope for the current study. There are a range of strategies that have been shown to be effective in managing various contaminants in municipal organics streams in other jurisdictions, but whether these strategies are necessary or appropriate in a WA context, and the extent of key risks and controls that may need to be implemented requires further research. However, some key considerations relevant to FOGO-derived products are outlined below.

4.2.3.1 Physical contaminants

According to AORA, the single greatest issue facing the organics recycling industry is the contamination of feedstocks, overwhelmingly plastics. Other contaminants include glass, metals, treated timbers, textiles and household hazardous waste, electronic waste (e-waste), engineered and treated timbers and other building rubble.[11]

Community education to highlight the importance of appropriate source separation, and to minimise contamination, is critical to achieving cost-effective processing and minimising the level of physical contaminants in the final product. The need for community education and consistent messaging is ongoing, and there have been numerous examples of Councils achieving physical contamination rates of less than 1% (by mass) on a consistent basis.

Managing physical contaminants in the FOGO waste bioconversion process, however, requires a combination of physical and mechanical intervention post-collection to remove contaminants within the process and in product refining, and may also involve blending with other ameliorants such as sand, clay or other composted products to produce market appropriate FOGO-derived products.

4.2.3.2 Chemical contaminants

Chemical contaminants can be present in a variety of waste streams and the sources of these types of contamination in municipal FOGO can include plastic packaging, lawn care products (non-biodegradable herbicides and pesticides), incorrectly disposed e-wastes and household hazardous wastes, and persistent garden-care chemicals which do not readily break down in the composting process (or in nature).

It is known for example, that the pesticide bifenthrin, often tested for alongside the standard analysis suite of AS4454-2012 (albeit not specifically listed as a requirement), has been found to be consistently near or even in excess of the maximum allowable concentration for unrestricted use in FOGO-derived composts in WA and other states. Its presence in the FOGO stream may result from use of ant and lawn grub and beetle control products in residential lawn maintenance, introduced to FOGO waste via lawn clippings.

4.2.3.3 Biological contaminants

International experience with biological pathogens from meat and meat by-products entering the livestock food chain (CJD/BSE) led to regulation excluding meat and meat by-products from recycled organics processing, or a requirement for thermal treatment to inactivate biological contaminants; for example the European Union animal by-products regulations (ABPR).

Other biological contaminants of concern in organics sourced from municipal garden organics can also include plant diseases, insect pests, weed seeds and plant propagules.

These and other pathogens are generally effectively managed through appropriately controlled composting processes, where pasteurisation is achieved, although some can require extended duration and/or further elevated temperatures for elimination.

4.2.3.4 Understanding the significance of contaminants in FOGO

Recent publicity surrounding the detection of a persistent selective herbicide (clopyralid) in recycled organics produced from garden wastes in Melbourne have highlighted the need for vigilance and further research to identify source of contamination, risks and mitigations. This research could then inform appropriate management of chemical contaminants in recycled organics generally, including municipal FOGO wastes.

Contaminants that have potential to be present in organics streams directed to composting processes could include the following:

- Persistent herbicides, such as clopyralid
- Persistent pesticides, such as bifenthrin
- Dieback (*phytophthera*), pests, other diseases or pathogens (e.g. *phylloxera*, Myrtle Rust; neither yet in WA)
- Per- and polyfluoroalkyl substances (PFAS)

[11] AORA. 2021. Vision 2031: The 10 year Roadmap for Australia's World Leading Organics Recycling Industry.

– Phthalate esters (plasticisers in plastics)
– Microplastics

It is important to note that the occurrence and significance of the presence (and concentrations) of these contaminants, if present at all, is not well understood and further research is needed to understand whether or not the above and any other contaminants are cause for concern in municipal organics streams generally, and not just in the FOGO waste stream.

It is understood that the cost of testing for certain contaminants can be prohibitive. It is therefore considered that routinely analysing and characterising FOGO-derived products for the presence of many of the above contaminants is beyond the financial capacity of individual processors and if investigation is proposed, it should be undertaken on an industry-wide basis, with funding support from Government.

Table 16 highlights the contaminants "of most concern" to key market segments as indicated during stakeholder consultation. It was found that weeds, pathogens and chemical contaminants are a greater concern to the broader market than physical contaminants, which end users assumed would be managed to an acceptable quality standard in FOGO-derived products prepared for sale.

Table 16 Market tolerance for contamination

	LG - Parks and gardens	Road development (major projects)	Mine rehabilitation	Extensive agriculture (cereal and livestock)	Extensive agriculture (forestry)	Intensive agriculture (grazing)
Weeds	✗	✗	✗	✗	✗	✗
Disease (e.g. pathogens)	✗	✗	✗	✗	✗	✗
Plastic	✗	Undesirable but some tolerance	✗	✗	Undesirable but some tolerance	✗
Glass	✗	Undesirable but some tolerance	Undesirable but some tolerance	✗	Undesirable but some tolerance	✗
Chemical contamination	✗	Some tolerance	✗	✗	✗	✗
Heavy metals	✗	Some tolerance	✗	✗	✗	✗

4.3 Key barriers and opportunities

Table 17 provides a summary of shared market barriers described above, with recommendations for key opportunities to overcome these based on stakeholder recommendations and success factors identified from national and international market research.

Table 17 Overview of key barriers and opportunities (informed by consultation)

Stakeholder	Barriers	Opportunities
Local Government	**Unwillingness of Councils to take responsibility for feedstock contamination** Local governments control the price paid to processors for converting FOGO waste collected into market-aligned products. Processors have no influence or control over quality of FOGO collected and delivered to them for processing, and councils need to take responsibility for ongoing community education and feedstock contamination management. The survey indicated limited willingness from councils to share contamination management costs and product sales with their processor, and only one of the 18 council respondents indicated a willingness to pursue contamination levels below 5%. The same council respondents indicated: - a willingness to increase contamination monitoring and pursue interventions to reduce contamination, and - interest in making FOGO-derived products available to residents at no cost This indicates that circularity around feedstock quality management may have some support, albeit indirect at this point.	- Include a buy-back clause balanced by rise and fall provisions in contracts between councils and processors. - Funding from landfill levies, gate fees or directly from councils should be explored to introduce short-term subsidies/discounts to purchasers to incentivise near-term uptake of FOGO-derived products. - Require all councils to regularly audit FOGO waste collected and report on contamination levels, informing messaging and ongoing community education to reduce contamination.
	A lack of sustainable procurement by State and Local Government Of the 18 Local Governments that completed the online survey, only three have Sustainable Procurement Guides with defined targets to measure use of recycled organics, and only one reported having clearly defined actions to achieve set targets. The results indicate that Sustainable Procurement Guides have not been developed by most councils, and where they have been developed, the guides lack clear actions and strategies to meet the set targets. Based on these results, it is unlikely that councils are currently 'buying back' recycled organic products from their processors. For councils, key drivers for purchasing FOGO-derived products were indicated as being related to strategic outcomes: - Closing the loop on their organic waste and supporting circular economy (80%) - Improving soil structure/quality (including nutrient and water retention) (37%) - Reducing quantity of synthetic fertilizers applied (or frequency of applications) (26%)	- Include a buy-back clause in contracts balanced by rise and fall provisions between councils and processors. - Mandate targets for procurement of minimum recycled content by State Government Departments and Local Governments. - Trials in relevant market contexts to demonstrate cost savings and other benefits. - Ensure all FOGO-derived products are quality managed for conformance to an appropriate Australian Standard and align with market expectations.

Stakeholder	Barriers	Opportunities
	This barrier is further exacerbated by a perceived lack of communication and collaboration between Councils' Parks and Gardens departments and their Waste Management departments. The most procured recycled organic product within Councils is mulch (indicated by over 70% of Councils in online survey responses) and the volume of soil amendments to be purchased as conforming to AS4454/AS4419 standards are therefore likely to be currently quite small.	
Processors	**Perception of high contamination and processing costs leads to unwillingness to process FOGO** Some organics recycling industry participants (in other countries and jurisdictions) indicated that FOGO is no longer accepted by them as a feedstock due to the ongoing issues with contamination and market expectations around products. Contamination management is a key concern and barrier to market development. Some processors indicated a perception that the end market will not pay more for FOGO-derived products than for recycled organics products from other inputs (FOGO is not considered to be a value add). The indication is therefore that "the customers are inclined to pay the amount they currently pay for organic compost products" and therefore Councils should be prepared to pay for the additional cost of managing contaminants in feedstock and processing this into market-aligned products. A key strategy currently employed by processors experienced in manufacturing and refining GO-derived and FOGO-derived products, to meet market expectations around quality and visible contaminants, is fine-screening to (nominally) less than 8mm particle size to remove physical contaminants. FOGO-derived products are consequently mainly limited to composted soil conditioners rather than mulches.	- Fund trials to support an end-user education campaign on the benefits of specific FOGO-derived products in appropriately selected market applications. - Explore formalising restrictions on sale and use of synthetic fertilizers in certain markets/locations (like the voluntary accord around fertiliser use in the Swan and Canning River catchments), encouraging uptake of recycled organic alternatives. - Councils responsible and accountable for reducing FOGO feedstock contamination, and required to undertake and report on regular audits. - Allow for longer term contracts (>10 years) and terms allowing higher gate fees charged for excessive feedstock contamination (request from processors, noting it is Councils that often dictate contractual terms). - Monitor, audit and reduce FOGO feedstock contamination at source such that processing facilities need to manage less contamination to enable cost-effective manufacture of high-quality products (10% contamination too high, target should be less than 1%).
	Processing of FOGO feedstock is cost prohibitive Processors are interested in advanced and innovative technology for organics recycling, such as anaerobic digestion and in-vessel composting, but investment uncertainty resulting from incomplete policy and regulatory framework implementation presents unacceptable commercial risks. Examples cited of investment uncertainty related to incomplete policy framework included: – Draft Guideline: Better Practice Composting – unfinalised, and	- Require FOGO-derived products to meet an appropriate quality specification and/or Australian Standard appropriate to the selected market (AS4454 for composts, AS3743 for potting mixes, AS4419 for landscaping soils). This may be addressed by imminent release of DWER Guideline: Better Practice Composting - Introduce short-term transport subsidies to extend reach, supporting establishment of new, large volume agricultural end markets, growing overall capacity for organics recycling generally, and FOGO-derived products specifically.

Stakeholder	Barriers	Opportunities
	– Proposed End of waste framework – waste derived material determinations; not yet implemented or fully articulated and may increase cost of recycling.	- Provide funding to support processors in their transition to processing FOGO as new markets are pursued and developed. Funding may support: • Investment in advanced and innovative processing technologies • Removal of contaminants from FOGO feedstock (i.e. through investment in high efficiency decontamination equipment) • Testing of products to monitor contamination levels in feedstock and end products • Feasibility studies for advanced technologies to produce a pelletised (or liquid) product. • Trials of pelletised and unpelletised FOGO-derived products in local agronomic contexts
Markets and end users	**Perception that FOGO-derived products would be contaminated, limiting market demand** Below are the top five barriers identified by end-users: 1. Contamination in products is too high 2. Inconsistent product quality 3. Cost of transport will be too high 4. Cost of product will be too high 5. Lack of demonstrated benefits and cost savings. According to the survey, the most important considerations for end users purchasing FOGO-derived products are: - Quality - ensure the product is manufactured and classified to the relevant standard and specification - Price - must be competitive with similar products and deliver similar or better results - Avoidance of contaminants ranked in order (disease/pathogens, chemicals, heavy metals, glass, weeds and plastics) This indicates that product quality (i.e. low contamination), consistency, performance and transport costs are key considerations when assessing 'value for money'.	The most highly recommended opportunities, as ranked by end-users, were: 1. Support council investment in feedstock auditing, community education and targeted intervention to reduce contamination in their collected FOGO 2. Funding made available to processors to invest in technology to remove contaminants from FOGO feedstock and/or increase testing of products, where current commercial arrangements had not accounted for this 3. Tailored specification/standards/certification for FOGO-derived products designed to meet the needs of specific end markets 4. Ensure all FOGO-derived products are quality managed and conform to AS4454 5. Fund market development education campaigns to share demonstrated benefits 6. Develop policy/legislation for sustainable procurement by all levels of government of recycled materials (incorporating FOGO products) with measurable targets 7. Develop policies that support achieving the WA Waste Strategy 2030 targets for processing of FOGO into saleable products 8. Develop guidance on how to successfully apply FOGO-derived products within target markets. Investing in trials through peak bodies and industry groups for chosen end markets may help to demonstrate the value and benefits of recycled organics generally, and specifically of FOGO-derived products, in previously undeveloped market segments. Product specifications and usage guidance can also be developed based on the results of trials. Appropriate testing regimes are required to ensure product quality can be maintained and product suppliers 'trusted', and productivity improvements and other benefits need to be communicated to new users in target markets.
	Cost versus value Assuming product met appropriate quality standards, the price points potential end-users (excluding councils) indicated they would be willing to pay for FOGO-derived products ranged from 'not knowing' to 'free' and 'up to $20 per tonne'. This is quite low, and it was identified that councils were willing to pay higher prices; as much as $60 per tonne. It should be noted however, that	

Stakeholder	Barriers	Opportunities
	councils alone do not currently use enough recycled organics products to absorb the full volume of FOGO-derived products expected to be generated from the Perth and Peel region. Additional market capacity must therefore be developed. It was also noted from stakeholder interviews that some FOGO-derived products are currently being sold for around $40 per tonne ex-works, while others are being 'sold' at $0 per tonne ex-works to support product familiarisation and trialling, where farmers pay for transport to collect from the processor and deliver to their property, commonly over distances of 50 to 100 km. The market for FOGO-derived products in WA is therefore considered immature and in need of further development.	
	End markets not aware of benefits of FOGO-derived products From consultation it was noted that agricultural markets are experiencing ongoing challenges with current practices, with key concerns being nutrient deficiencies (100% of respondents), non-wetting soils (80%) and low organic matter (60%). These would likely be priority considerations in any trials undertaken to improve awareness and develop demand for FOGO-derived products. Each market has its own unique characteristics and needs. Therefore, accessing markets requires understanding each markets specific needs and tailoring products (and standards/specifications) to meet these needs. Not all identified markets responded to the online survey. This could indicate a lack of interest from some market segments; a lack of market understanding of the potential benefits, or a negative experience with recycled organic products relating to inconsistent product quality or contamination. It was clear from consultation that there was low awareness of FOGO-derived products, including cost versus benefits, which is unsurprising given the relative newness of FOGO processing Australia-wide.	
	Regulatory framework - Australian Standard AS4454 is insufficient to regulate the process It is clear that AS4454 is considered the most important standard by most stakeholders. It is important to also break down the feedback and consider the opinions of waste generators (Councils), processors and end users separately. Apart from AS4454, other standards and published guidance such as AS3743, AS4419, AS6000, draft DWER Guideline: Better Practice Composting, DPIRD general guidance, Fresh Care Food Safety and Quality Program, and EcoHort EMS Certification; were	

Stakeholder	Barriers	Opportunities
	variously nominated by survey respondents (from multiple choice listing) relevant to definition of product specification and quality standards, depending on their area of interest. It must be noted that none of the above-mentioned standards and guidance documents are mandatory requirements, and these documents are generally intended to operate as voluntary standards. Stakeholder feedback also indicated that there is a lack of understanding around what products and quality parameters AS4454 can define and over 60% of stakeholders suggested that AS4454 needs amending. Stakeholder suggestions on which aspects of AS4454 should be amended were: - Quality management controls should be strengthened, inclusive of the number of samples required, with consideration of the cost benefit of sampling regimes - The standard, or certain criteria within the standard, could be modified or selectively applied to suit different markets, given that they may have different tolerances.	

5. Moving forward – suggested actions

To support the Waste Authority in achieving its 2030 vision that “Western Australia will become a sustainable, low-waste, circular economy in which human health and the environment are protected from the impacts of waste” the next steps identified are designed to overcome key barriers discussed in Section 4 around:

– Contamination
– Regulatory policy uncertainty
– Market perceptions
– Lack of understanding of FOGO-derived products and their potential benefits.

Table 18 presents a selection of higher priority next steps to address key barriers whilst delivering on the Strategy purpose:

The purpose of this Strategy is to guide the Waste Authority in identifying priority next steps to develop and maintain end-markets for FOGO-derived products in Western Australia building on the Waste Strategy 2030.

The recommended actions are designed to support Councils and organics processors through guidance, education, and funding to promote a circular waste economy, focusing on the recycling and beneficial use of FOGO materials.

A full list of recommended actions in provided in Appendix C.

Table 18 Next steps

Action	Description of desired result	Barrier overcome by action	Market opportunity to be realised
Maximise strategic outcomes for WA			
Develop policy framework for Councils on how to introduce collection services for FOGO-wastes that encourage and achieve consistently low contamination levels.	Alter Local Government perception around 'cost of processing' and 'value for money' if there is an equal or greater cost to dispose to landfill Ability to reduce future costs Contamination levels in FOGO services are recognised to be the responsibility of Councils	Lack of policy framework to encourage Councils to introduce collection services that achieve FOGO feedstock with low contamination Contamination in FOGO-derived products that does not meet market expectation	**All markets** Contamination is a critical barrier to be overcome to access and grow all markets; in particular those with the largest potential demand and/or hypothetical annual value: - Extensive agriculture (cereal and livestock) - Intensive agriculture (grazing) - Local Government (parks and gardens) - Urban amenity (residential)
Develop guidance around how to best manage FOGO feedstock contamination	Develop best practice guidelines that support introduction of education, contamination monitoring and other interventions to successfully control and reduce contamination Local Governments to implement interventions for managing feedstock contamination, which may include: - Monitoring contamination with cameras (e.g. in the hopper of the collection truck) - Issuing warnings to residents for incorrect bin use (e.g. warning stickers) - Face-to-face consultation with residents (where contamination issues are identified) to offer support and guidance on correct bin use - Consultation with drivers to identify offending/problem collection areas - Detailed composition audits on all three kerbside bin streams - Monitor sources of feedstock contamination. In areas where contamination is unacceptably high, first issue warnings/advice notes and undertake consultation. If bin contamination continues, withdraw the FOGO bin and revert to 240 litre red lid bin; allow opt-in for return to FOGO service if/when requested	Lack of guidance to encourage Councils to introduce collection services that achieve FOGO feedstock with low contamination Contamination in FOGO-derived materials and products that does not meet market expectations or support demand growth	**All markets** Contamination is a critical barrier to be overcome to reach all markets, in particular those with the largest product demand and/or hypothetical annual value: - Extensive agriculture (cereal and livestock) - Intensive agriculture (grazing) - Local Government (parks and gardens) - Urban amenity (residential)
Introduce mandatory requirement for Local Governments to audit FOGO collected and report contamination statistics and their progress towards 'target zero' Introduce deadline for reporting and penalties for non-compliance Publish data on *My*Council[12] website (Department of Local Government, Sport and Cultural Industries)	Annual auditing and reporting by all Councils in Perth and Peel collecting FOGO waste, for comparison with best practice performance FOGO waste has less than 3% contamination (by mass) in councils that have been collecting FOGO for less than 2 years FOGO waste has less than 1% contamination in councils that have been collecting FOGO for more than 2 years Long term, strive towards significantly less than 1% contamination, targeting zero contamination in FOGO waste collected Trend monitoring feeds into ongoing community education and messaging	Lack of regulatory drivers requiring Councils to introduce and provide collection services that achieve FOGO feedstock with low contamination Lack of transparency on contamination levels achieved by Councils collecting FOGO materials Continuous improvement to minimise FOGO waste contamination, enabling cost-effective processing into products that meet market expectations	**All markets** Contamination is a critical barrier to be overcome to reach all markets, in particular those with the largest product demand and/or hypothetical annual value: - Extensive agriculture (cereal and livestock) - Intensive agriculture (grazing) - Local Government (parks and gardens) - Urban amenity (residential)
State Government to mandate targets for State Government Departments and Local Governments to procure minimum recycled content that conforms with relevant Australian Standards and market-aligned specifications for FOGO-derived products	Grow market demand for FOGO-derived products Make targets, and results achieved, reportable to drive action Targets should align with relevant objectives and principles in the WA Sustainable Procurement Guideline[13] and WA Supply Commission Sustainable Procurement Policy[14] (Department of Finance, 2020)	Lack of 'buy back' by Councils collecting FOGO materials A lack of sustainable procurement by State and Local Government Contamination in FOGO-derived products that does not meet market expectation	Promote development of the following markets: - Local Government (e.g. urban amenity and landscaping) - State Government Departments (e.g. major road and rail development projects)
Develop measurable targets for Local Governments and processors	Targets may relate to: – FOGO feedstock contamination reduction – FOGO-derived product contamination – FOGO-derived product procurement (buy-back) and reuse	Lack of policy framework to encourage Councils to introduce and operate collection services that achieve FOGO feedstock with low contamination Lack of policy framework to encourage processors to achieve low levels of contamination in FOGO-derived products Lack of 'buy back' by Councils collecting FOGO materials Contamination in FOGO-derived products that does not meet market expectations to support demand growth	**All markets** Contamination is a critical barrier to be overcome to reach all markets, in particular those with the largest product demand and/or hypothetical annual value: - Extensive agriculture (cereal and livestock) - Intensive agriculture (grazing) - Local Government (parks and gardens) - Urban amenity (residential)
Collaborate and educate for success			
Engage with peak bodies, (e.g. AORA, WALGA), to tighten existing guidance and standards to improve QA/QC of FOGO-derived products, tied back to managing contamination levels in FOGO waste collected.	Tightening of existing standards will improve product quality in the near term, improving marketability, until such time as a new standard or market aligned specifications for FOGO-derived products are developed. Improving product quality and consistency is the first step required to develop new and	Existing Australian Standards (e.g. AS4454) are insufficient to regulate contamination and are voluntary guidelines only Contamination in FOGO-derived products that does not meet market expectations	**All markets** Contamination is a critical barrier to be overcome to reach all markets, in particular those with the largest product demand and/or hypothetical annual value:

[12] Department of Local Government, Sport and Cultural Industries. 2021 (www.wa.gov.au)
[13] Department of Finance WA. 2020. Sustainable procurement guideline. (**Error! Hyperlink reference not valid.**
[14] Department of Finance WA. 2021.**Error! Hyperlink reference not valid.**. (www.wa.gov.au).

Action	Description of desired result	Barrier overcome by action	Market opportunity to be realised
	existing markets for FOGO-derived products, particularly those which are most sensitive to contaminants.		- Extensive agriculture (cereal and livestock) - Intensive agriculture (grazing) - Local Government (parks and gardens) - Urban amenity (residential)
Develop a platform/forum/webinar series for Regional Local Government / Local Government / Processors to share learnings	Foster better/best practice management Reduce feedstock contamination Produce high quality end products Provide opportunity for collaborative information exchange and knowledge transfer	Lack of information sharing between Regional Local Government / Local Government / Processors	**All markets** Improving feedstock and therefore product quality will support demand development in all markets
Develop a state-wide approach to community education around FOGO	Reduce additional cost burden on Local Governments and organics processors introducing and operating FOGO collection/processing services Messaging should be simple, consistent and catchy, building on successes elsewhere Education should: - Target grassroots change (i.e. provide education through schools) - Target the entire organics supply chain (residents, drivers, pickers, processors, end markets). - Showcase success stories - Showcase benefits of FOGO-derived products and returning recycled organics to soil - Seek to educate residents on correct source separation to reduce feedstock contamination, including addressing common misconceptions (i.e. the difference between compostable and biodegradable bags). - Shift mindset towards viewing education as an investment, not a cost	Lack of householder and market understanding of the value of FOGO-derived products and applying these back to the soil Lack of householder knowledge and understanding on the importance of correct source separation to reduce feedstock contamination Contamination in FOGO-derived products that does not meet market expectation	**All markets**
Provide funding support to Local Governments to develop education material for their residents	Develop localised marketing material Run TV / radio / social media campaigns Build on educational material developed by states with the most experience in FOGO recycling (NSW, SA, Victoria)	Lack of householder and market understanding of the value of FOGO-derived products and applying these back to the soil Lack of householder knowledge and understanding on the importance of correct source separation to reduce feedstock contamination Contamination in FOGO-derived products that does not meet market expectation	**All markets**
Fund community education campaigns to share demonstrated benefits for end markets to change the perception around FOGO derived products being low value	Based on trial data made in WA and the development of new product specifications, new regulations and policies to control contamination levels. Inform and educate end markets on the benefits to change their current perception around FOGO-derived products as not being high enough quality to add value.	Lack of market understanding of the value of FOGO-derived products and applying these back to the soil Market perception that FOGO-derived products are low quality (potentially contaminated) and inconsistent	**Local Government (parks and gardens)** **Urban amenity (residential)**
Regulate the direction			
Finalise and issue Guideline: Better Practice Composting	Greater investment certainty for Councils, Processors and a basis on which to build capacity in existing markets for recycled organic products, and specifically to facilitate development of market capacity for FOGO-derived products.	Lack of clarity around regulatory and policy settings for organics recycling facilities and quality management requirements Investment uncertainty shared by Councils and Processors	**All markets**
Increase the landfill levy to further disincentivise disposal of recyclable organic material (e.g. FOGO) to landfill *Note: Review of the WA Waste Avoidance and Resource Recovery (WARR) levy framework has been in development for some time and it is expected that a schedule of planned increases will be published on completion of the levy review.*	Divert more organic waste from landfill Alter Local Government perception around 'cost of processing' and 'value for money' if there is an equal or greater cost to dispose to landfill Alter Local Government perception of FOGO as a 'waste' to FOGO as a 'valuable resource' and opportunity to reduce cost	Perception by Councils that recycling FOGO is a 'cost' to be avoided and the erroneous view that contamination management is the solely the processor's responsibility Investment uncertainty shared by Councils and Processors	**All markets** Build market trust that supply is consistent and available when needed Better able to supply project-based demand: - Road and rail development (major projects) - Mine rehabilitation projects - Property development (major projects)
Councils required to commit to funding of ongoing community education to support contaminant reduction in FOGO collections	A minimum annual budget commitment based on a set rate per household per annum to maintain effective, ongoing and consistent messaging to communicate the importance of FOGO quality management to householders and that 'the FOGO recycling process starts at the household'	Lack of resident understanding of the value of FOGO-derived products and applying these back to the soils Lack of resident knowledge on correct source separation to reduce feedstock contamination Contamination in FOGO-derived products that does not meet market expectation	**All markets**
Implement the 'end of waste' framework – Waste derived material determinations (or similar instrument)	Greater investment certainty for Councils, Processors and a basis on which to build capacity in existing markets for recycled organic products, and specifically to facilitate development of market capacity for FOGO-derived products.	Absence of clear policy and regulatory framework, giving processors certainty when investing in new or upgraded infrastructure	**All markets**
Collaborate with industry, state government and federal government to develop a new standard for FOGO-derived products.	Build market trust and demand through developing a standard specifically for FOGO-derived products, with specifications for target markets which meet product quality and contamination expectations	Contamination in FOGO-derived products that does not meet market expectation	**All markets** Contamination is a critical barrier to be overcome to reach all markets, in particular those with the largest product demand and/or hypothetical annual value:

Action	Description of desired result	Barrier overcome by action	Market opportunity to be realised
The quality assurance framework must be built on the requirements from each end market, to develop industry specific 'fit-for-purpose' product specifications. The resulting standard must meet market expectations for quality and risk (contamination) tolerance. This may include stricter testing and lower contamination tolerance.	A consistent high quality product will also increase market willingness to pay a higher price		- Extensive agriculture (cereal and livestock) - Intensive agriculture (grazing) - Local Government (parks and gardens)
Assess the need for the industry to introduce a new type of certification standard, which is applied to the whole supply chain (from feedstock to process to end product).	A more holistic approach to managing contamination. Supply-chain certifications are common internationally and have been shown to produce higher quality end products. Review international lessons learnt (Appendix A).	Disconnect in quality expectations held by processors and Councils, resulting in contamination in FOGO-derived products that does not meet market expectation	**All markets** Contamination is a critical barrier to be overcome to reach all markets, in particular those with the largest product demand and/or hypothetical annual value: - Extensive agriculture (cereal and livestock) - Intensive agriculture (grazing) - Local Government (parks and gardens)
Promote commerciality			
Facilitate trials with State Government Departments, Local Government, and emerging markets to assess performance (cost and other benefits) of FOGO-derived products	Trials should seek to demonstrate: - Consistent high quality products (low to no contamination) - Cost benefits (compared with competing products) - Other benefits sought by target markets Trials should seek to assess: - Price point for FOGO-derived products - Optimal application method and rates for each key market	Lack of market understanding of cost (and other) benefits from applying FOGO-derived products Market concern that FOGO-derived products might be too expensive (with transport cost on top) Lack of market understanding on how FOGO-derived products should be applied (application rates and frequency)	All markets, however, those likely to benefit most include: - Broad-acre agriculture (cereal and livestock) - Forestry - Mine rehabilitation - Intensive agriculture - Local Government (parks and gardens) - Road and rail development (major projects)
Develop guidance (informed by trials) for application of FOGO-derived products in selected markets	Guidance material is tailored towards target markets Recommend application methods, timing and rates Provide evidence of benefit relative to cost	Lack of market understanding on how FOGO-derived products should be applied (application rates and frequency) Increase familiarity and trust in products	All markets, however, those likely to benefit most include: - Broad-acre agriculture (cereal and livestock) - Forestry - Mine rehabilitation - Road and rail development (major projects)
Introduce short-term subsidies/discounts to target markets to incentivise uptake of FOGO-derived products	Time-limited subsidies and discounts encourage use of FOGO-derived products (over organics products currently used), enabling markets an opportunity to test the quality and benefits derived from product use Assuming FOGO-derived products are of a consistently high quality with low levels of contamination, this process may help establish market trust and drive demand growth for FOGO-derived products	Stockpiling of large volumes of FOGO-derived products in semi-urban areas (odour issues, cost exposure)	It is expected that the following markets would develop faster with financial incentives: - Urban amenity (residential) - Broad-acre agriculture (cereal and livestock) - Intensive agriculture - Forestry - Mine rehabilitation
Undertake consultation with the most promising markets to identify internal processes / protocols which may need to undergo review prior to purchasing FOGO-derived products.	Understand internal processes/protocols of State Government Departments Identify documents or contracts which may require amending/ updating to facilitate use of FOGO-derived products (e.g. landscaping specifications, contractor requirements). Encourage State Government Departments to update these.	A lack of sustainable procurement by State and Local Government Contractor or other internal specifications or guidelines do not require use of recycled (organic) materials	- Mine rehabilitation - Road and rail development (major projects)
Establish regional facilities for temporary storage of FOGO-derived products to increase transport efficiencies and reduce transport cost for buyers where purchase commitments exist. Minimise ad-hoc stockpiling of organic materials in semi-urban areas which has the potential to cause odour issues, retard market growth.	Satisfy project-based and campaign-based supply commitments where product delivery and application activities are time constrained and/or seasonal (e.g. infrastructure projects and extensive agriculture) Reduce net transport costs Reduced stockpiling of organics in urban and semi-urban areas	High transport cost (a perceived market barrier) Inability to supply large volumes to meet project-based demand (major projects) Stockpiling of large volumes of FOGO-derived products in semi-urban areas (causing odour issues)	All regional markets, however, those likely to benefit most include: - Road and rail development (major projects) - Infrastructure projects - Broad-acre agriculture (cereal and livestock) - Forestry - Intensive agriculture - Mine rehabilitation
State/National Government to make funding available to undertake research to identify chemical contaminants (in FOGO wastes collected) that are of greatest concern to target markets, potential sources and suitable mitigations, based on learnings internationally and in other Australian jurisdictions.	Clear understanding of the extent, prevalence and range of concentrations of contaminants of concern found in FOGO-derived products in Western Australia. Sensitive markets have confidence that contamination risks are appropriately mitigated and managed	Chemical contamination in FOGO-derived products that does not meet market expectation Perception that FOGO-derived materials/ products may contain excessive levels of chemical contaminants	All markets Markets with no tolerance for chemical contaminants include: - Broad-acre agriculture (cereal and livestock) - Extensive agriculture (grazing) - Turf production Markets with a very low tolerance for chemical contaminants include: - Local Government (parks and gardens) - Property development (major projects) - Urban amenity (residential) - Forestry - Mine rehabilitation - Extensive agriculture (orchards and tree crops)

Action	Description of desired result	Barrier overcome by action	Market opportunity to be realised
			- Extensive agriculture (market gardens) - Extensive agriculture (vineyards)
Foster circularity			
Develop guidelines for standardised better practice FOGO processing contracts that support development of high-quality FOGO-derived products	Local Government include a "buy back" clause with processors which will: Underwrite annual sales for a proportion of the total FOGO derived products produced Drive improvements in feedstock quality through alignment of commercial objectives Provision in contracts to allow processors to charge a higher gate fee to Local Governments where contamination exceeds agreed levels Rise and fall provisions in contracts Provision in contracts for Local Government to purchase FOGO-derived products at a discount rate (to incentivise use)	Lack of interest by Councils to take responsibility for reducing contamination in FOGO feedstock Lack of 'buy back' by Councils collecting FOGO materials Lack of regulatory drivers requiring Councils introduce collection services that achieve FOGO feedstock with low contamination Disconnect in quality expectations held by processors and Councils, resulting in contamination in FOGO-derived products that does not meet market expectation	**All markets** Contamination is a critical barrier to be overcome to reach all markets, in particular those with the largest product demand and/or hypothetical annual value: - Extensive agriculture (cereal and livestock) - Intensive agriculture (grazing) - Local Government (parks and gardens)
State Government to consider making funding available to assist processors in transition to FOGO to: - Invest in innovative processing technologies - Remove contaminants from FOGO feedstock (i.e. through investment in high efficiency decontamination equipment) - Increase testing of products to meet stricter standards - Explore the feasibility of investing in advanced technologies to produce a pelletised (or liquid) product.	Reduce cost burden on processors for processing FOGO-derived products Build market confidence in product quality Applicants should demonstrate how funding will assist them in achieving Strategy targets and vision	Contamination in FOGO-derived products that does not meet market expectation Pelletised or liquid product would overcome cost barrier associated with applying products on a larger scale, by applying products during seeding	**All markets** Contamination is a critical barrier to be overcome to reach all markets, in particular those with the largest product demand and/or hypothetical annual value: - Extensive agriculture (cereal and livestock) - Intensive agriculture (grazing) - Local Government (parks and gardens) Markets most interested in advanced products (e.g. pelletised or liquid products) include: - Extensive agriculture (cereal and livestock) - Intensive agriculture (grazing) - Intensive agriculture (hemp)
State Government to make available funding for trials to demonstrate cost (and other) benefits in target markets to use in market education campaigns	Overcome market perceptions (particularly those held by Local Government) that FOGO-derived products are or will be contaminated and the product quality inconsistent Uptake of new products and technologies is progressive; farmers trust other farmers and are more likely to consider new practices if benefits are demonstrated locally. Trials will support this process. Focus on key markets: Extensive Agriculture (forestry, cereal, stock) and Mine Rehabilitation. Characterise performance of FOGO-derived products to enable reliable competition with fertilizers and other established soil amendments. Trials should consider exploring the role FOGO-derived compost can play in disease suppression/resistance	Lack of market understanding of cost (and other) benefits from applying FOGO-derived products Market concern that FOGO-derived products might be too expensive (with transport cost on top) Lack of market understanding around how FOGO-derived products should be applied (application rates and frequency)	All markets, however, those likely to benefit most include: - Broad-acre agriculture (cereal and livestock) - Forestry - Mine rehabilitation - Intensive agriculture - Local Government (parks and gardens) - Road and rail development (major projects)
Explore regulatory mechanisms for reducing use of chemical contaminants in commercial and residential garden maintenance Interventions may include banning retail sale of certain persistent pesticides and herbicides or limiting herbicide use, or directing residents to discard 'treated' vegetation/lawn clippings via red-lid bin instead of FOGO bin	Reduce the risk of persistent chemicals contaminating FOGO feedstock and FOGO-derived products.	Chemical contamination in FOGO-derived products that does not meet market expectation	All markets Markets with no tolerance for chemical contaminants include: - Broad-acre agriculture (cereal and livestock) - Extensive agriculture (grazing) - Turf production Markets with a very low tolerance for chemical contaminants include: - Local Government (parks and gardens) - Property development (major projects) - Urban amenity (residential) - Forestry - Mine rehabilitation - Extensive agriculture (orchards and tree crops) - Extensive agriculture (market gardens) - Extensive agriculture (vineyards) - Extensive agriculture (hemp).

6. Glossary

Term	Definition
Better practice	Better practice refers to practices and approaches that are considered by the Waste Authority to be outcomes-focussed, effective and high performing, which have been identified based on evidence and benchmarking against comparable jurisdictions. Better practice will be supported by the Waste Authority through the development of better practice guidelines, measures and reporting frameworks, which will be developed to reflect the different capacities and challenges faced by waste generators and managers. Better practice is synonymous with the term best practice but captures the dynamic nature of best practice.
Circular Economy	An alternative to a traditional linear economy (make, use, dispose) in which we keep resources in use for as long as possible – extracting the maximum value from them while in use, then recovering and reusing products and materials. Three core principles underpin a circular economy – design out waste and pollution; keep products and materials in use; and regenerate natural systems.
Contaminants	Any non-compostable items in the organics waste stream.
Food organics and garden organics (FOGO)	Food organics include waste food, inedible food, and parts of food that are not consumed and/or are considered undesirable (such as seeds, bones, coffee grounds, skins and peels). Garden organics include organic wastes that arise from gardening and maintenance activities, such as lawn clippings, leaves, cuttings and branches. FOGO can also include other organic wastes that may be compatible with FOGO collections and can include items such as paper and cardboard. In the context of this Strategy, FOGO waste is taken to mean municipal organic waste source-separated by householders and separately collected by Councils via mobile garbage bin (MGB) for processing into recycled organic products, collectively referred to in this Strategy as 'FOGO-derived products'. It is noted that source-separated FO and GO from commercial sources could be incorporated into FOGO processing systems, subject to system limitations and appropriate commercial arrangements, once these facilities are established.
Kerbside collection	A regular containerised service that collects waste from a resident's kerbside. In the context of this Strategy, kerbside collection is intended to be consistent with the system described in the Waste Authority's Better practice FOGO kerbside collection guidelines (v2, Jan 2021)
Organic waste	Waste materials from plant or animal sources, including garden waste, food waste, paper and cardboard.
Perth and Peel region	The Perth region, or Perth metropolitan region, is the area defined by the Metropolitan Region Scheme. The Peel region is the area defined by the Peel Region Scheme. Municipal solid waste targets are set for the Perth and Peel region to reflect current urbanisation trends and to align with waste infrastructure servicing and planning needs.
Resource recovery	The process of extracting materials or energy from a waste stream through re-use, reprocessing, recycling or recovering energy from waste.
Waste diversion	The act of diverting a waste away from landfill for another purpose such as re-use or recycling.

Appendix A

Background Research

Appendix A - Background Research

Market Development Strategy for FOGO-Derived Products

Waste Authority

16 June 2021

→ **The Power of Commitment**

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Printed date	16/06/2021 10:37:00 AM
Last saved date	16 June 2021
File name	https://projectsportal.ghd.com/sites/pp18_03/marketdevelopmentstr/ProjectDocs/12541803-0_Appendix A_Background Research.docx
Author	L Nordin, S Isbister
Project manager	Natarsha Anne Woods
Client name	Waste Authority
Project name	Market Development Strategy for FOGO Derived Products
Document title	Appendix A - Background Research | Market Development Strategy for FOGO-Derived Products
Revision version	Rev 0
Project number	12541803

Document status

Status Code	Revision	Author	Reviewer		Approved for issue		
			Name	Signature	Name	Signature	Date
S3	A	L Nordin S Isbister	T Woods		M Gravett		04/06/2021
S4	0	L Nordin S Isbister	T Woods	pp	M Gravett		16/06/2021

Executive summary

The Waste Avoidance and Resource Recovery Strategy 2030 (Waste Strategy 2030) aims for Western Australia (WA) to become a sustainable, low-waste, circular economy in which human health and the environment are protected from the impacts of waste. The Waste Strategy 2030 identified organic waste as a focus due to the quantities generated and associated impacts on the environment. A key commitment was pursuing better practice waste management, including roll out of a consistent three bin kerbside collection system, which includes separation of food organic and garden organic (FOGO) waste from other waste categories, by all local governments in the Perth and Peel region by 2025.

The Waste Authority established a FOGO Reference Group to develop a plan for the introduction of FOGO collection services. The FOGO Reference Group, with stakeholders from local and state governments, and the organics recycling sector, identified market development as critical to the successful roll out of FOGO services.

Preliminary work recognised potential resistance to purchasing and/or using FOGO derived materials due to:

- Real or perceived issues with product quality, including contamination
- A lack of clarity around standards that apply to various end use applications
- A lack of quality assurance systems and testing regimes to verify product quality
- A lack of confidence in, or knowledge of, FOGO-derived products.

The WA Waste Authority, through the Department of Water and Environmental Regulation (DWER), engaged GHD to develop a Market Development Strategy for FOGO-Derived Products (the Strategy), to guide subsequent market development actions to 2025.

The purpose of this report (Appendix A) is to provide an appreciation of the current status of organics recycling in Australia and more specifically WA, leverage learnings from global leaders in FOGO recycling, and identify existing, potential and emerging markets for FOGO-derived products in WA. This document also provides an overview of processing technologies, FOGO-derived products, competing (or companion) products, and regulatory frameworks for product quality control and assurance. This research underpins the overarching Strategy.

This report should be read in conjunction with the Strategy and appendices B through D:

- Appendix B – Review of Market Opportunity
- Appendix C – Recommended Actions
- Appendix D – Reference List.

The organics recycling sector is an important contributor to the Australian economy with a collective industry turnover of over $2 billion (AORA 2021b). The focus of the overarching Strategy and associated research (this report) is municipal FOGO from household kerbside collections. There are 563 councils in Australia, of which 121 (around 40%) have introduced a FOGO service (DAWE 2020), with NSW, SA and Victoria leading the way. WA currently has at least 10 active FOGO collection services.

In WA's Perth and Peel region there are currently five councils offering a FOGO service (East Fremantle, Fremantle, Melville, Bayswater, Bassendean) and one offering a FO service (Perth). This is expected to grow to 33 in line with the Waste Strategy 2030 commitments. Outside the metropolitan region, Bunbury Harvey Regional Council (BHRC) processes FOGO from collections across the councils of Bunbury, Capel, Donnybrook-Balingup, Augusta-Margaret River and Harvey. The Shire of Dardanup is planning to roll out FOGO collection in October 2021, with processing to be undertaken by BHRC. In the Perth and Peel region, the Town of Cambridge and Cities of Wanneroo, Stirling, Subiaco, Swan, Gosnells, Kalamunda, Kwinana, Mandurah and many others are understood to be actively planning FOGO implementation.[1]

There are currently two organics processing facilities in proximity to the Perth and Peel region processing FOGO waste (**BHRC** *Banksia Road* and **Purearth** *Woottating*); a further four sites are approved for FOGO processing and are in various stages of facility construction or product trials (**Go-Organics** *Boonanarring*, **BHRC** *Australind*, **SUEZ** *North Bannister*, **EMRC** *Red Hill*).

[1] Based on media announcements and online survey

Based on DWER / Waste Authority projections reviewed and endorsed by the FOGO Reference Group (2021), the roll out of FOGO services in the Perth and Peel region is expected to produce around 145,000 tonnes per year of FOGO-derived products by 2025. Based on research by AORA, there is currently only annual market demand for around 220,000 tonnes of recycled organic products in WA, the majority derived from FO, GO, timber, biosolids and other organics. There is a risk that without market growth, FOGO-derived products may erode or displace other recycled organic products in existing markets, which is considered undesirable. Therefore, further market development will be needed to support demand creation for FOGO-derived products. Increased market demand for FOGO-derived products will help to develop the circular economy around organics recycling in WA.

There are three main organics processing approaches relevant to this Strategy, being open windrow composting (including aerated static pile), in-vessel composting, and anaerobic digestion.

Products derived from FOGO feedstock via composting technologies may include compost, soil conditioners, mulch, soil blends, pellets and granules. Due to challenges in cost-effectively removing physical contaminants from the oversize fraction of the final screening operation, most processors consulted suggested that a mulch product from FOGO was unlikely to represent a significant proportion of FOGO-derived products produced.

End products from anaerobic digestion are primarily biogas and digestate. Digestate can be further processed to produce a value-added product. Solid digestate can be composted to achieve pasteurization and reduce odour.

All recycling processes will need to manage feedstock and product contamination. This includes a need for developing context-appropriate acceptance criteria (at the processing facility), inspection procedures for incoming feedstock and processes for contaminant removal, residuals management and product quality monitoring.

A number of competing and companion products were identified including chemical (synthetic) feritlizers, as well as other forms of organic products including compost (derived from separate FO and GO streams), raw animal manures (including bedding litter), biosolids, soil amendments (clay, peat, aglime), and mulch.

In the extensive agricultural sector, synthetic fertilisers generally cost less to purchase and apply (per hectare), and when used in accordance with long-established guidance, deliver a predictable plant growth response. In the intensive agricultural sector (e.g. orchards), mulch provides a cost effective means of controlling weeds, conserving soil moisture, protecting against disease and soil erosion. It is expected that FOGO-derived composts can complement these products, however, cost and other benefits attributable to applying these products must be demonstrated and shared with end users.

FOGO-derived materials will likely be inputs to a range of blended, amended and value-added products. It is important that FOGO-derived products find a place in the market where they can be sold affordably and create sustained market demand, at a quality standard appropriate to the markets they are sold into.

Australia’s current regulatory framework for organics recycling is inconsistent across all jurisdictions.

Australia has several national voluntary standards relevant to defining quality parameters in products containing recycled organics; the most popular being AS4454: *Australian Standard for composts, soil conditioners and mulches*. The Commonwealth Department of Agriculture, Water and Environment (DAWE) is currently reviewing standards applicable to organics recycling, with the objective of identifying potential to streamline standards, testing regimes and the policy framework surrounding them.

The five key market sectors identified from this market research were:

– Urban amenity / landscaping (local government, private residential, property development)
– Extensive agriculture (cereal, livestock, forestry)
– Intensive agriculture (grazing, hemp, turf production, vineyard, orchards, market gardens)
– Rehabilitation (local government, mine rehabilitation, road and rail development)
– Remediation (local government, consultants).

This report is subject to, and must be read in conjunction with, the limitations set out in section 1.2 and 1.3, and the assumptions and qualifications contained throughout the report.

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1. Introduction

Organic waste is a significant component of the residual household waste stream across Australia. Recycling organic materials instead of allowing them to be lost in landfill, where they represent a missed opportunity and a source of pollution, is a key priority in Australia's transition to a circular economy. Nationally, there is now strong momentum to increase uptake of Food Organic Garden Organic (FOGO) services with state and territory Environment Ministers in April 2021 agreeing in principle to support roll-out of FOGO collection services in all jurisdictions.

Currently five councils in the Perth metropolitan region are offering a FOGO service, and this is expected to grow to 33 in line with a commitment in the Waste Strategy 2030 to "Roll out a consistent three bin kerbside collection system including separation of FOGO from other waste categories, by all local governments in the Perth and Peel regions by 2025". The Waste Authority's 'Better Practice FOGO Kerbside Collection Guidelines' (Version 2, January 2021) encourages high performing systems to provide two collection services each week, consisting of a weekly FOGO service together with a rotating fortnightly general waste service and comingled recycling service, comprising:

- General (residual red-lid bin) waste: preference 140 litres per fortnight
- Co-mingled (yellow lid bin) recycling: at least 240 litres per fortnight
- FOGO: preference – 240 litres per week

The $20 million Better Bins Plus: Go FOGO initiative of the Waste Authority further supports Local Government implementation of a separate FOGO service.

The key to successfully diverting municipal FOGO from landfill is closing the loop by finding appropriate end markets for FOGO-derived products and creating ongoing demand. The recycling of organics provides opportunities for new employment and investment, while the end products have the potential to deliver land care benefits across multiple sectors (i.e. agriculture, mining, transport, local government).

The 2007 "Assessment of Markets for Recycled Organics in Western Australia" prepared by Research Solutions on behalf of the former Department of Environment and Conservation (now the Department of Water and Environmental Regulation (DWER)), provides a useful benchmark for understanding the change in market perceptions and key drivers.

With a renewed focus in WA on diverting organic waste from landfill, separating the collection of municipal organic wastes, and combining food organic (FO) and garden organic (GO) wastes via kerbside collection of FOGO, there is an imminent need to grow existing markets and to establish new markets for FOGO-derived products. To achieve this, consideration must be given to key market drivers, potential market capacity, and factors influencing each market's willingness to accept and utilise FOGO-derived products.

The Perth and Peel region is uniquely positioned to readily access end-users, since there are already multiple facilities approved for FOGO waste processing that are widely distributed and generally located outside the metropolitan area. This enables municipal organic wastes to be transported from the metropolitan area for processing at recycling facilities in urban fringe, semi-rural or rural settings, effectively improving access of end products to regional markets such as extensive agriculture, intensive agriculture, and minesite rehabilitation. It is also therefore commercially feasible to return FOGO-derived products to their metropolitan source for use in urban amenity and other beneficial reuse applications since the transport distances involved are not excessive.

1.1 Purpose

The purpose of this report is to identify markets for FOGO derived materials and identify the key issues, barriers and actions required to develop those markets. This Market Development Strategy for FOGO-Derived Products is intended to guide subsequent market development actions to 2025. This Background Research report is intended to provide an appreciation of the current status of organics recycling in Australia, and more specifically WA, leverage learnings from global leaders in FOGO recycling and to identify existing, potential and emerging markets

for FOGO-derived products in WA. This document also provides a high level overview of FOGO processing technologies, FOGO-derived products, competing (or companion) products, and regulatory frameworks for product quality control and assurance. This research underpins the overarching Market Development Strategy for FOGO-Derived Products.

1.2 Scope and limitations

Scope items relating to this background research report include:

- Desktop review of existing information, studies and reports that are relevant to organics recycling in south-west WA, and in particular, the Perth and Peel regions
- Leverage learnings from other states and overseas (relating to FOGO collection, processing and end-use)
- Review of national and international papers/articles/reports to leverage learnings from existing users of FOGO derived compost
- Identify and understand the scope and potential range of FOGO-derived products
- Identify existing and potential end-users of FOGO-derived products
- Assess product risks and available quality control mechanisms (i.e. regulations, standards, testing, guidance)
- Assess high-level, indicative costs of transport.

Scope limitations include:

- Research focus on municipal FOGO, rather than source separated FO and GO, or combinations thereof
- Research focus on FOGO waste collected from kerbside of single unit dwellings (SUDs), and low-density multiple unit dwellings (MUDs), rather than high-rise MUDs or commercial business sources
- Assessment of existing and emerging markets is limited to south-west region of WA, primarily servicing FOGO waste to be generated in the Perth and Peel region
- Consultation - targeted markets generally occurring within a nominal radius of 200 km of organics processing facilities approved or understood to be seeking approval for FOGO processing
- Market sizing (Appendix B) was based on markets occurring within a nominal radius of 100 km of organics processing facilities approved or understood to be seeking approval for FOGO processing
- Processing technologies have been described at a high level and only in the context of processes considered relevant to FOGO processing
- Multi-criteria analysis (MCA) was limited to markets that participated in the online survey or interview, where sufficient information and data was available to quantify and assess market potential.

1.3 Disclaimer

This report has been prepared by GHD for the Waste Authority, pursuant to engagement of GHD by DWER on behalf of the Waste Authority and may only be used and relied on by the Waste Authority for the purpose agreed between GHD and the Waste Authority as set out in section 1.1 of this report.

GHD otherwise disclaims responsibility to any person other than the Waste Authority arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on information shared by DWER and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

1.4 Australian organics recycling industry overview

During 2018-19, Australia generated over 40 Mt of organic wastes and 14.9 Mt of this was from the following three sectors Municipal Solid Waste (MSW), Commercial and Industrial (C&I), Construction and Demolition (C&D) sector. The total recovery rate for organics nationally was around 49% (noting this also included agriculture, fishery and forestry wastes). In the same timeframe, a total of 5.60 Mt of food waste was produced in Australia, and of that, 3.76Mt was sent to landfill and the balance was otherwise disposed of.[2]

Organics (food and green waste combined) represent more than half of the waste that goes into the average Australian household's general waste bin, and there are both financial and environmental benefits to be achieved by recovering and recycling organics. Organics has therefore become a priority waste for Australia to divert from landfill. According to Rabobank's Food waste report 2019, Australia wasted a total of $10.1 billion worth of food waste during 2019. To fight the food waste problem, the Federal Government has set a National Food waste target to halve organic waste being disposed at landfill by 2030 and this aligns with the global target that the United Nations has set for the world.

The Government's latest budget released in May 2021 indicates that $67 million is to be invested in new food organic and garden organic (FOGO) waste initiatives, including the establishment of a Food Waste for Health Soils Fund, aimed at diverting organic material from landfill to productive use in agricultural soils.

Waste Management and Resource Recovery Association (WMRR) CEO, Gayle Sloan, noted:

"We know that Australia has some of the driest soils in the world and as a country, we generated 42.9 million tonnes of organic waste in 2018-19, with FOGO making up a total of 20% of that volume. That year alone, 6.87 million tonnes in total were deposited to landfill,"[3]

As a result, State and Territory Governments around Australia are creating strategy and policy settings aimed at reducing organic waste disposal to landfill.

1.4.1 Key drivers for recycling organics in Australia

As mentioned above, in the National Waste Policy Action Plan, the Government has set a national target for Australia to halve the amount of organic waste disposed at landfill by 2030. It is also injecting grant funding into the market; an example being the $1.3 billion Modern Manufacturing Initiative (MMI) that is directed to industry to develop waste infrastructure and reprocessing of recyclable waste streams. According to the National Waste Report 2020, Australia has only reduced the quantity of organics sent to landfill by 2% since 2016, indicating there is a still more to be done to achieve the targets (noting the National Waste Report used 2018-19 data).

According to the Australian Organics Recycling Association (AORA), in 2018/19 Australia's organics recycling industry resulted in more than 4,800 jobs, paying over $366 million in wages and salaries, with average employee earnings of $75,540. This sector is currently providing a $724 million direct value-add to the Australian economy annually.

The Greenhouse gas saving from achieving 100% recycling of organic wastes is approximately 3.8 million tonnes of CO_2-equivalent (CO_2-e) annually, equivalent to planting 5.7 million trees or taking over 870,000 cars off the road. Although it is unrealistic to expect that 100% of all recyclable organic waste can or will be recycled, the positive impacts of preserving the inherent value in this material and the benefits of recycling as much of this material as practicable back to soils, are significant.

Some key social, financial and environmental benefits of diverting organics from landfill are:

- Achieve national, state and local government strategy targets
- Increased lifespan of existing landfills, reduced leachate generation, and reduced need for new landfill development
- Increased employment, with approximately one job supported for every 1,550 Mt of organics recycled in Australia[4]

[2] Peter Olah. March 2021. Online presentation to AORA members
[3] Waste Management and Resource Recovery Association of Australia (WMRR). 2021. Federal Budget – a multi-faceted driving force.
[4] AORA. 2020. Economic contribution of the organics recycling industry

- Avoided landfill emissions
- Increased land-based carbon sequestration (one tonne of composted garden organics applied to land can sequester approximately 0.5 tonnes of CO_2-e)
- Potential for significant cost savings relative to landfill disposal (including levies)
- Improved soil structure, fertility, nutrient cycling, nutrient retention and moisture retention
- Improved plant survival, productivity, and resilience to pests and disease
- Reduced pesticide, synthetic fertiliser and water use.

The organics recovery rate of each State and Territory for 2018/19 is presented in Figure 1. The data presented is based on industry research undertaken by AORA. The organics recycling sector is an important contributor to the Australian economy with a collective industry turnover of over $2 billion (AORA 2021b).

As shown in Figure 1, South Australia has the highest organics diversion rate nationally, and Northern Territory the lowest, with WA currently the second lowest performing jurisdiction. It should be noted that this graph includes all organics (i.e. FO, GO, waste timber, biosolids and other organic wastes).

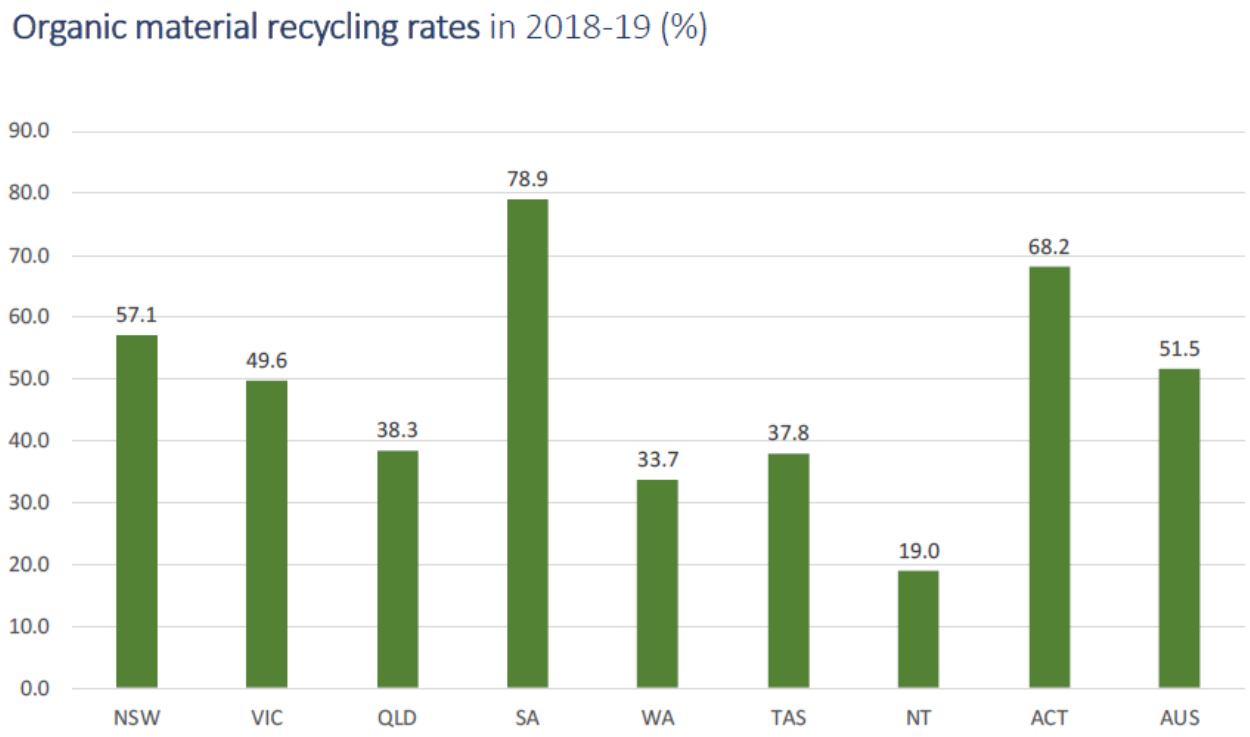


Figure 1 ***Organic material recycling rates in 2018/19 (AORA, Feb 2021)***

1.4.2 Provision of FOGO collection services in Australia

According to the interactive database on the Department of Agriculture, Water and Environment (DAWE) website (updated June 2020) there are 563 councils in Australia, of which 121 (around 40%) have introduced a FOGO service.

The roll out of FOGO services in Australia is not new. For example, in NSW the City of Lismore introduced a FOGO service in 2000, and Penrith followed in 2010. Lismore was the first Council in Australia to achieve 'organic certified compost' accreditation.

At the time of developing this Strategy, NSW has over 50 councils offering a FOGO service, SA has close to 30 councils and Victoria has more than 40 Councils offering a FOGO service. Other States and Territories have not come as far but are following the lead of other states; WA now has at least 10 active FOGO services, Tasmania

currently has six operating FOGO services while Queensland, ACT and Northern Territory are yet to implement all-in FOGO services.

1.4.3 End markets for FOGO-derived products

Soil around the world is under threat. Soil is a complex mixture of minerals, organic matter, air and water. It can take many thousands of years to form but can be destroyed very quickly (sometimes within decades) through poor land management practices, urban development and the effects of climate change.[5] In WA the depletion of soil organic carbon is critical and a well-known issue, and if not managed correctly, more farmland in WA will become unproductive.[6] Introducing FOGO-derived product can help degraded and carbon-depleted soils to recover.

Key to successful diversion of FOGO waste from landfill is closing the loop by identifying and developing appropriate end markets for products, and establishing ongoing demand. Several end markets already exist for recycled organics, with the main market segments across Australia being urban amenity, extensive agriculture (including broadacre), intensive agriculture (horticulture, viticulture), enviro-remediation and rehabilitation. It is likely that many of these markets will be the focus for FOGO-derived products. However, according to AORA, there is currently only sufficient established market demand for FOGO-derived products to cover sales in NSW, SA and ACT. Further work is needed to develop market capacity in other states.

In an article published in Waste Management Review (Feb 2021), University of Queensland's Johannes Biala stated that the circular economy for recycled organics in Australia is "of sorts" there when it comes to the urban amenity chain but "certainly not for agriculture markets". He noted that "key to success is to create a market driven by demand and economic advantage for all supply chain partners and that now is the time to establish a framework and structural changes to achieve this goal".

1.4.4 Development of FOGO in Western Australia

In WA, there are several policies that drive development of FOGO services and therefore increasing the tonnage for FOGO-derived products. The WA Waste Strategy 2030 states that Western Australians should protect the environment by managing waste responsibly. Targets in the Waste Strategy 2030, relevant to development of FOGO-derived products, are that by 2030:

- No more than 15% of waste generated in Perth and Peel regions is landfilled
- All waste will be managed and/or disposed to better practice facilities
- Material recovery will have increased to 75%
- WA will have realised a 20% reduction in waste generation per capita

The Western Australian Climate Policy (DWER, 2020) also commits the State Government to working with all sectors of the Western Australian economy to achieve net zero GHG emissions by 2050 and in the interim to achieve the Australian Government's interim target of emission reductions of 26 - 28 per cent by 2030. Consideration of GHG emissions is a requirement of the environmental approvals process. The WA Environmental Protection Authority (EPA) has developed guidelines on how GHG emissions need to be considered when undertaking the environmental impact assessment (EIA) process. The State Emissions Policy also commits the State Government to working with all sectors of the Western Australian economy to achieve net zero GHG emissions by 2050 and in the interim to achieve the Australian Government's interim target of emission reductions of 26 - 28 per cent by 2030. Consideration of GHG emissions is a requirement of the environmental approvals process. The WA Environmental Protection Authority (EPA) has developed guidelines on how GHG emissions need to be considered when undertaking the environmental impact assessment (EIA) process.

1.4.5 Circular economy around organics in WA

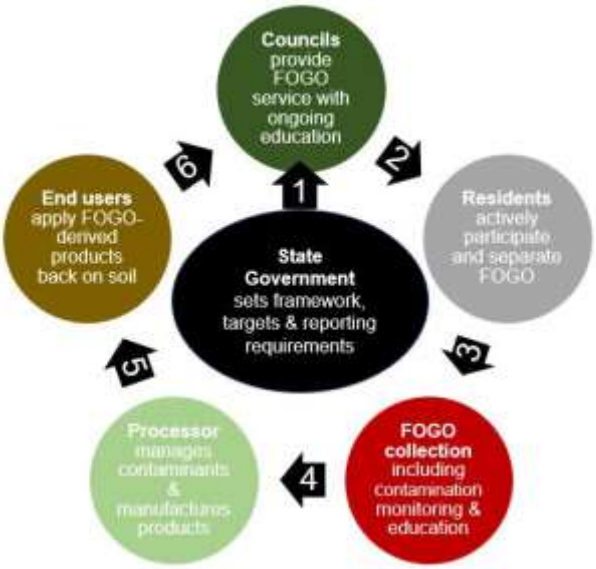
What drives a successful circular economy around organics is to provide high quality end products that allows for development of end markets that demand FOGO derived products and are willing to pay a price that is higher than what it cost to produce. This price is likely superior to the current low-cost and low-benefit options that is often

[5] ISWA. 2020. Benefits of composting and anaerobic digestate when applied to soil.
[6] Carbon Ag. 2020. Carbon pellets.

being generated today. A functioning system requires cooperation from all stakeholders and a win-win system for all supply chain partners.

For FOGO management services to be successful in WA, a circular economy around municipal recycled organics needs to be established, guided by the principle that existing markets for recycled organics products from other sources are not disrupted, distorted, eroded or displaced by the additional products generated through FOGO collection. The whole supply chain, from Councils offering the service, to processors manufacturing and selling FOGO-derived products, to end markets where these products can nourish to flourish, needs to be well understood, appropriately aligned and risks appropriately allocated.

The FOGO circular economy supply chain



Circular economy

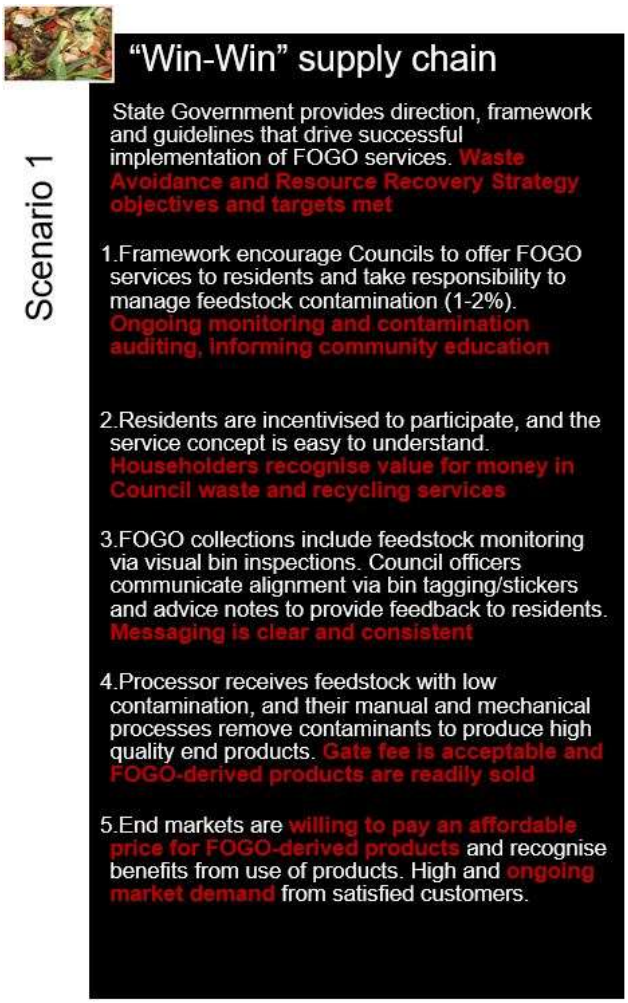
"If the product is free from contamination, you are effectively removing the main barrier to markets!"
Brendan Doherty, SMRC

"It is not just about providing the service it's about doing it right with low contamination to ensure that you close the loop" Lyall Davieson, Cockburn Council

Quotes from stakeholder consultation.

There are many steps in the process that need to align. Key to success is a framework that engenders success from the outset and can deliver a feedstock low in contaminants such that processors can cost-effectively manage their process and generate FOGO-derived products that meet market expectations. Based on the market research undertaken in developing this Strategy, appropriate supply chain alignment is key to developing viable markets for FOGO-derived products in WA.

The following two scenarios demonstrate supply chains based on either win-win values vs misalignment of key elements.



1.4.6 Understanding feedstock and FOGO-derived products

Different collection methods generate different feedstock characteristics and often result in different end products, often tailored to specific market segments and uses. Different demographics can influence the effectiveness of community education around collection arrangements. Processing approaches need to be appropriate for the feedstock characteristics, and products matched to appropriate end markets. A range of parameters will determine which solutions are likely to be the most commercially viable and appropriate for a given circumstance.

Figure 2 below provides an overview of the variety and potential complexity of recycling system approaches and alignment of opportunities that exist in the organics recycling sector.

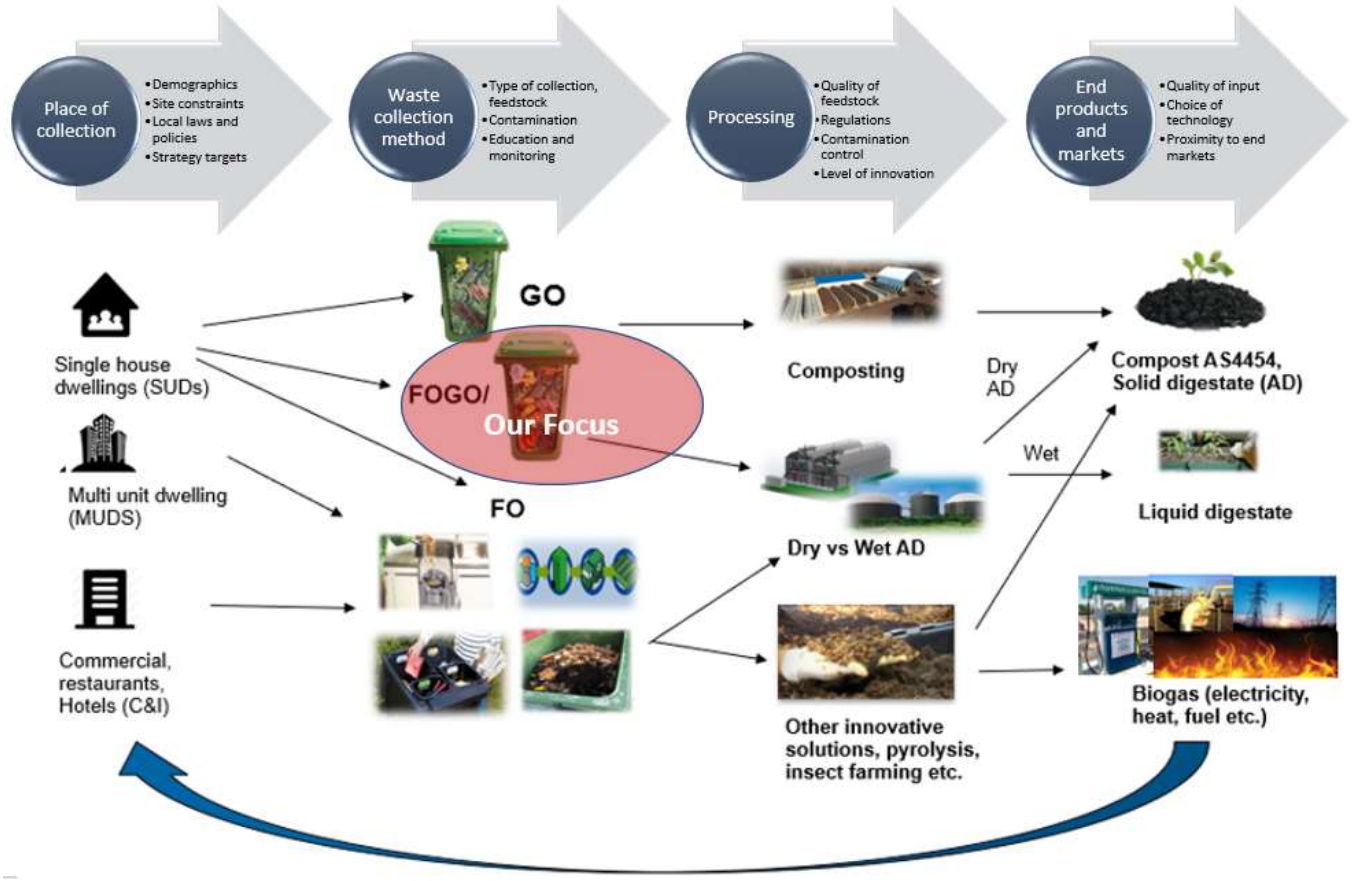


Figure 2 Overview of organics recycling systems and material flows

This strategy is focussed on identifying end markets from FOGO derived products; thus, this strategy does not specifically consider the potential additional tonnage of FO and GO that is available in WA from commercial customers producing organic feedstock for processing into recycled organics. This also excludes the FO tonnage that can be collected from commercial customers and/or high-density dwellings as these buildings usually have minimal amount of GO in their feedstock.

In this report the focus is on the markets for FOGO derived products, which means that this is limiting consideration of the FOGO feedstock to municipal kerbside (household) services. Commercial industries rarely, if ever, combine the collection of the two streams (FO and GO), however these separate streams are combined in appropriate ratios by processors when composting, to produce recycled organic products.

2. FOGO in WA

The number of Councils in WA offering a FOGO service is growing in line with a commitment in the Waste Strategy 2030 to:

Roll out a consistent three-bin kerbside collection system including separation of FOGO from other waste categories, by all local governments in the Perth and Peel regions by 2025.

Currently there are at least 5 councils offering a FOGO service (East Fremantle, Fremantle, Melville, Bayswater, Bassendean) and one offering a FO (Perth) service in the Perth and Peel region. However, outside the metropolitan region, Bunbury Harvey Regional Council (BHRC) processes FOGO from collections across the councils of Bunbury, Capel, Donnybrook-Balingup, Augusta-Margaret River and Harvey. The Shire of Dardanup is planning to roll out FOGO collection in October 2021, with processing to undertaken by BHRC.

In the Perth and Peel region, the Town of Cambridge and Cities of Wanneroo, Stirling, Subiaco, Swan, Gosnells, Kalamunda, Kwinana, Mandurah and many others are understood to be actively planning FOGO implementation.[7]

2.1 FOGO collection

The $20 million Better Bins Plus: Go FOGO Program initiative of the Government of Western Australia is delivered by the Waste Authority is a program that will further supports local governments to provide better practice three-bin kerbside collection systems with a separate FOGO service[8] The Waste Authority's Better practice FOGO kerbside collection guidelines (Version 2, January 2021), a better practice kerbside collection system includes source-separated FOGO and incorporates the following mobile garbage bin (MGB) collection services:

- General waste: preference – 140 litres per fortnight
- Co-mingled recycling: no less than 240 litres per fortnight
- FOGO: preference – 240 litres per week

The guidelines state that high performing systems provide two collection services each week, consisting of a weekly FOGO service and a rotating fortnightly general waste service/comingled recycling service.

Figure 3 Kerbside collection system recommended in Better practice FOGO kerbside collection guidelines[9]

Based on DWER/Waste Authority projections reviewed and endorsed by the FOGO Reference Group (2021), the roll out of FOGO services in the Perth and Peel region is expected to produce around 145,000 tonnes per year of FOGO-derived products by 2025, as shown in Figure 4.

[7] Based on media announcements and online survey.
[8] Waste Authority WA. 2019. Better Bins Plus: Go FOGO.
[9] Waste Authority WA. 2021. Image from Better practice FOGO kerbside collection guidelines, Version 2.

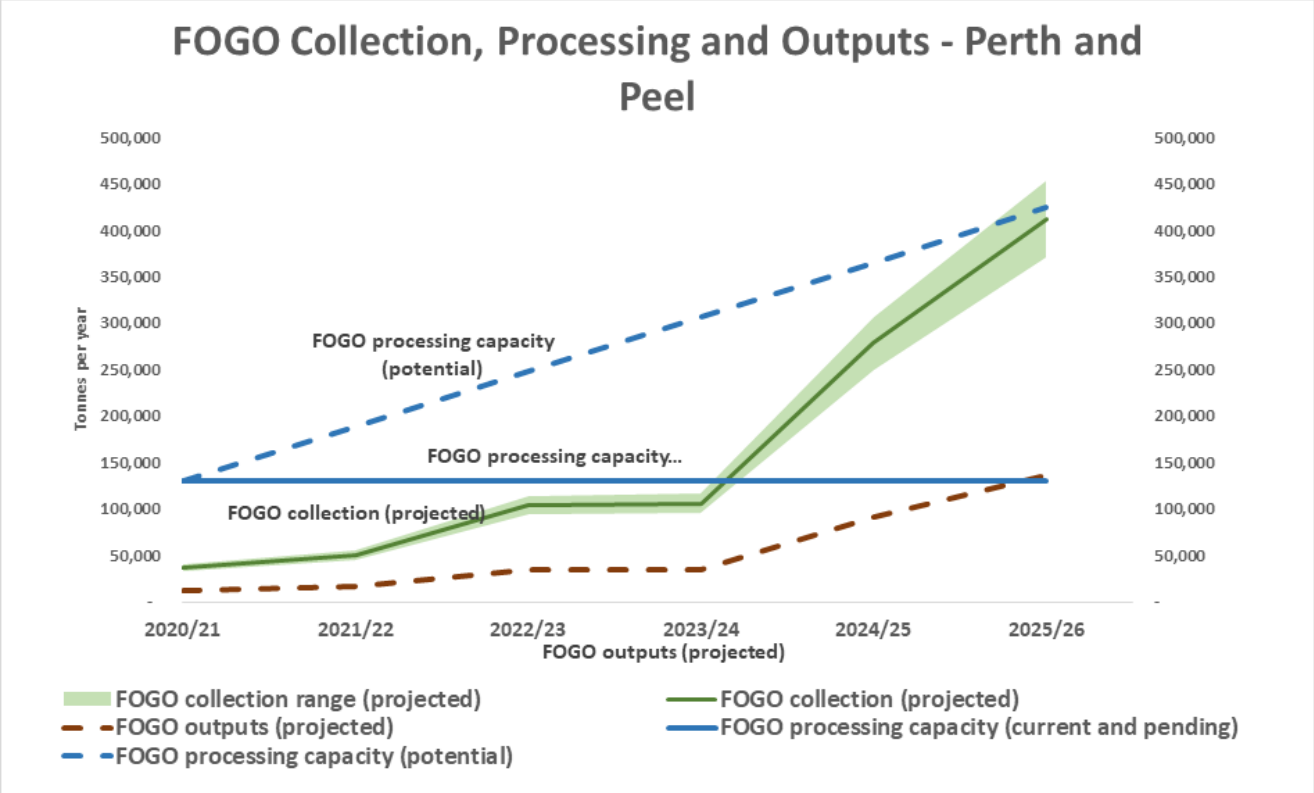


Figure 4 FOGO projections for the Perth & Peel region (Waste Authority, 2021)

For this calculation, the following has been assumed:

- 50% moisture in FOGO materials
- Tonnage captures from FOGO collection 3.29 kg per person per week and feedstock contamination at 2.6% (Southern Metropolitan Regional Council's FOGO trial levels in Melville)
- Higher contamination rates that include oversized material are not factored into the model (as that is not the real contamination rate)
- Carbon loss of 46% after composting, which is in line with the 2011 report done for NSW EPA.
- Windrow composting is the processing method (other systems may have different outcomes)
- Reintroduce moisture to the volume (20-30%)

There are several parameters in this calculation that can vary, as indicated in Table 1 below.

Table 1 Parameters influencing total quantity of FOGO-derived products.

	Parameters that may vary	How these can vary
1	Participation and bin presentation rate (includes number of households actively participating)	Depending on socioeconomic factors in the collection area, outcomes may vary. Participation rate has been seen to improve over time (to around 80%).
2	Diversion rate	This can vary from region to region and between single unit dwellings (SUD's) and multi-unit dwellings (MUD's). Best practice in Australia says [10]9.43 per participating household and bin and Penrith collects 9.03 kg similar to the 9.0 kg/hh/week according to [11]*"Better practice FOGO kerbside collection guideline"*. MUDs (such as townhouses) can often have less green waste in their bins than SUDs. Around 15% of the households are classified as medium to high density households in Perth & Peel region.

[10] DAWE. 2012. Food and Garden Organics: Best Practice Collection Manual (environment.gov.au).
[11] Penrith City Council NSW. 3-Bin Waste Service (nsw.gov.au).

	Parameters that may vary	How these can vary
3	Contamination rate	Can vary from more than 8% in early stages of implementation to less than 1% once fully implemented, with consistent messaging and ongoing community education.[12]
4	Mass loss through bioconversion process	Stakeholder engagement has indicated that the mass of FOGO-derived product remaining after composting and maturation could be as low as 25-30% of original feedstock mass due to carbon and moisture losses.

A sensitivity check was applied to the calculation deriving FOGO collection quantities presented in Figure 4 to create an interval between maximum and minimum scenarios for FOGO waste to be collected in the Perth and Peel region. The minimum scenario was created by changing by changing the following three parameters in the calculation:

1. Participation rate set to 80% and applied to SUD households only
2. Weekly tonnage per City of Penrith average bin weight (9.05 kg /bin / household per week)
3. Increased contamination rate from 2.6% to 5%
4. Reducing mass of FOGO-derived product after composting process to 30% of starting feedstock mass

Based on these assumptions, an annual tonnage of projected FOGO-derived output was calculated, resulting in an estimated annual production of (unamended) FOGO-derived materials of 145,000 tonnes.

It should be noted that this scenario is to be considered indicative only and the quantity may change significantly, depending on actual quantity of FOGO waste collected and processing technology applied. Other factors may also impact the tonnage projection, such as delays in rolling out FOGO services and processing arrangements, level of education provided, effectiveness of messaging and level of community engagement.

Table 2 FOGO-derived product projections interval for the region

Year	Min (scenario above)	Max (FOGO reference group)
25/26	105,015	145,000

Based on research by AORA, there is currently only annual market demand for around 220,000 tonnes of recycled organic products in WA. This would be enough should the volume of FOGO-derived products be directly proportional to the volume of GO-based products currently being sold, but this will not be the case. Although it can be expected that some percentage of the FOGO waste collected will be GO waste that is currently being recycled and sold into existing markets, In Table 3 below is an overview of tonnage of organic waste available for recycling in WA in 2018-19.

Table 3 Recycled Organics in WA 2018-19[13]

	WA	
Food Organics (FO)	95,633	20%
Garden Organics (GO)	216,161	45%
Timber	62,061	13%
Other Organics	5,608	1%
Biosolids	102,618	21%
Total	**482,082**	**100%**

There is a risk that without market growth, FOGO-derived products may erode or displace other recycled organic products in existing markets, which is considered undesirable. Therefore, further market development will be needed to support demand creation for FOGO-derived products. Increased market demand for FOGO-derived products will help to develop the circular economy around organics recycling in WA.

[12] EMRC. 2021
[13] Australian Economic Advocacy Solutions. 2020. Economic contribution of the organics recycling industry.

3. Overview of technologies and products

Municipal organics collection and processing options in WA have historically been primarily based around garden organics (GO), collected through a combination of bulk verge pick-ups, GO self-hauled to transfer stations, private contractors and in some cases, fortnightly kerbside collection in mobile garbage bins (usually 240 litre).

Commercial organics management options have included garden organics (GO) and more recently food organics (FO) with collection and aggregation by a number of means, usually via a combination of private sector and municipal operators. Other feedstocks have also usually been aggregated by processors to supplement revenues via gate fees and enhance their processing arrangements to produce market-appropriate products.

FOGO services are a relatively new initiative in Australia, and usually (currently) only offered through municipal organics collections from households.

3.1 Relevant processing technologies

There are four main types of organics processing technology relevant to this Strategy; being:

- Open windrow composting (including aerated static pile)
- In-vessel composting
- Dry anaerobic digestion
- Wet anaerobic digestion

The table below indicates the main types of processing technology and their suitability for nominated feedstocks. Suitability is indicated by colour coding, with green being suitable, amber indicating some restrictions may apply and red deemed generally unsuitable). Certain feedstocks, such as FO without GO, can require addition of structure material for effective aerobic composting.

Composting of feedstocks with high odour potential can be problematic if not appropriately managed. Open windrow composting may be suitable for FO and FOGO if the facility is appropriately located with suitable separation distance to sensitive receptors.

Table 4 Suitability of processing options for FO and GO

Feedstock	Open windrow composting	In-vessel composing	Dry anaerobic digestion	Wet anaerobic digestion
FO (only)				
GO (with or without FO)				
FOGO				

Other alternative waste technologies such as Mechanical Biological Treatment (MBT), and emerging energy from waste (EfW) technologies and processes (e.g. gasification and pyrolysis) can be applied to various organic waste streams. However, these technologies are not listed above as they are not generally applied to processing a source separated FOGO waste feedstock, where lower cost alternatives and demand exists for recycled organics products. MBT has generally been applied to mixed residual municipal solid waste (MSW) as the primary feedstock with the objective of producing compost from the biodegradable components (food, paper, garden waste etc) within that stream.

Although MBT technology has been applied to processing and recycling of residual MSW in the Perth region since the late 1990's, there is only one facility of this type still operating in the region (Biovision 2020 Neerabup waste facility under contract to Mindarie Regional Council), with several others having closed in the last decade. This technology has been used in other Australian states and internationally for many years, but increasing concern around the fate and concentrations of both physical and chemical contamination in end products has led to a move away from this processing approach.

The difference in contaminant levels between compost made from MSW and source segregated organics can be significant, and concern around the fate of contaminants was the basis for NSW EPA implementing a ban on the land application of 'mixed waste organic outputs', otherwise known as MWOO, or MSW compost, in NSW.[14]

Production of MSW compost through MBT facilities has therefore gradually been replaced with source separation of municipal and commercial organic wastes and directed towards the production and beneficial use of high-quality compost products in agriculture and horticulture.[15]

Although gasification, pyrolysis, advanced thermal conversion and other EfW technologies can use mixed residual waste streams as input (feedstock) to generate heat (e.g. in a boiler) or biofuels (including syngas, methanol, ethanol, hydrogen), only the biogenic component of the feedstock is considered renewable under the Australian Renewable Energy (Electricity) Act 2000 and Australian Renewable Energy (Electricity) Regulations 2001. These thermal processes create some renewable energy, which helps to achieve net zero emission targets. However, in comparison to anaerobic digestion (AD) and composting processes, thermal processes do not offer the soil conservation and agronomic productivity restoration potential of pasteurised and stabilised, quality-managed recycled organic products such as compost, that can be beneficially applied to carbon-deficient and degraded soils in WA.

FOGO services currently being implemented are directed at collecting organic waste from households only, and not from commercial businesses (yet). Potential exists for introducing source separated commercial FO and GO streams to FOGO processing operations, just as FOGO streams can be introduced into existing organics recycling operations once appropriate regulatory approvals are in place. However, the focus of this study and the Market Development Strategy for FOGO-Derived Products is municipal FOGO, from household kerbside collections.

FOGO processing may employ AD and/or aerobic composting to produce market appropriate products. However, AD processes produce solid (and sometimes also liquid) residue in the form of digestate. Digestate has potential to be beneficially used as a soil amendment, though it may require subsequent pasteurization to eliminate weed seeds and pathogens before application, depending on the AD process temperature, intended use of the product, the receiving environment and associated land use activities.

Although there are already WA guidelines for the application of biosolids (sewage sludge) to land[16], there are currently no published guidelines, or specific restrictions for that matter, around the land application of digestate in WA. The draft Guideline: Better practice composting, provides no guidance or recommendations on the management, use and sale of digestate from AD processes.

In the context of this study, digestate has therefore been assumed to be an intermediate product that, in the absence of current policy and regulatory guidance, and local sales precedent, may be composted as a means of cost effectively achieving pasteurization and odour reduction. Alternative approaches are available, but further consideration of these was considered outside the scope of this study.

Although end products may differ between an AD facility and a composting facility (open windrow or in-vessel), all recycling processes will need to manage feedstock and product contamination. This includes a need for developing context-appropriate acceptance criteria (at the processing facility), inspection procedures for incoming feedstock and processes for contaminant removal, residuals management and product quality monitoring.

Consultation with organics recyclers and processors already managing FOGO feedstocks indicated that most products derived from FOGO will likely be screened to a nominal particle size less than 10mm, and most likely less than 8mm, to meet acceptance criteria (e.g. in AS4454) for physical contaminants. Due to challenges in cost effectively removing certain physical contaminants, including hard plastics, from the oversize fraction of the final screening operation, most considered that a mulch product from FOGO was unlikely to be suitable for most markets, and therefore unlikely to represent a significant proportion of FOGO-derived products. Automated optical sorting technology may be capable of removing such physical contaminants, but its cost effectiveness in this context is currently unclear.

It is also possible that processors may elect to add ameliorants to FOGO-derived products to improve quality and enhance marketability, adapting blends to specific market requirements. It should be noted that products that

[14] NSW EPA. 2020: Future use of mixed waste organic outputs (www.epa.nsw.gov.au).
[15] Biala and Wilkinson. 2020. International Comparison of the Australian Standards for Composts, Soil Conditioners and Mulches (AS4454 – 2012).
[16] Department of Environment and Conservation. 2012. Western Australian guidelines for biosolids management

incorporate FOGO-derived products that may have already been tested for conformance with a nominated quality standard or product specification, should also be retested post-blending to ensure the final product also conforms with the specification appropriate to its intended market.

Table 5 below is a matrix over what organic processing facility that can create a certain type of FOGO derived products.

Table 5 FOGO-derived products vs organic processing technology

Type of FOGO-derived product (relevant standard)	Open windrow composting	In-vessel composting	Dry anaerobic digestion	Wet anaerobic digestion
Composted soil conditioner (AS4454)	✔	✔	✔	Unlikely from FOGO
Potting mixes (AS3743)	✔	✔	✔	Unlikely from FOGO
Mulch (AS4454)	Unlikely from FOGO	Unlikely from FOGO	Unlikely from FOGO	Unlikely from FOGO
Landscaping soils and soil blends (AS4419)	✔	✔	✔	Unlikely from FOGO
Pellets	✔	✔	✔	Unlikely from FOGO
Liquid digestate	✗	✗	Possibly[17]	Unlikely from FOGO
Solid digestate	✗	✗	✔	Unlikely from FOGO
Biogas	✗	✗	✔	Unlikely from FOGO

3.2 Composting techniques

Composting is a natural process involving the controlled microbial conversion of organic waste into useful recycled organic products in the presence of oxygen. Composting generates heat and control of process conditions through aeration and mixing or turning enables destruction of weed seeds and pathogens. The two most common types of composting approaches for are outlined below.[18]

3.2.1 Open windrow composting

FOGO waste is readily biodegradable and has high odour generation potential during the biological degradation process. Although FOGO can be treated via open windrow composting, this process is usually considered unsuitable for FOGO due to higher risk of odour impacts and potential for release of greenhouse gas emissions. There are however process variations available, incorporating forced aeration and removable windrow.

3.2.2 In-vessel composting (IVC)

In-vessel composting systems are fully contained within a vessel or enclosure and include tunnel, hall systems, vertical silo, drum or other similar enclosed processing component to produce a stable and quality-controlled compost. Organic materials are fed into the vessel or tunnel and subject to controlled environment conditions (temperature, moisture and aeration) for the first stage of the composting process (i.e. the pasteurisation stage that eliminates weed seeds and pathogens).

This IVC process is often followed by a secondary open-air compost curing and/or maturation phase. In-vessel processes are generally suitable for more odorous waste streams that includes food waste and are often modular systems that provide flexibility and allow for increased capacity.

[17] Preference would be to operate on a zero liquid discharge basis, via co-processing with composting to minimise excess liquid generation.
[18] Sustainability Victoria. 2018. RRE007 Guide to Biological Recovery of Organics (sustainability.vic.gov.au)

3.3 Anaerobic Digestion (AD)

AD is a biological process whereby organic material is converted into a biogas and a nutrient rich digestate that can either be used for fertiliser production or composting. The biogas principally contains methane and carbon dioxide and can be further utilised to produce heat, electricity, renewable natural gas (RNG) or compressed natural gas (CNG).[19] The process is well-suited to source separated organic wastes such as FO. A diagram of typical input and outputs at and AD facilities is included as Figure 5.

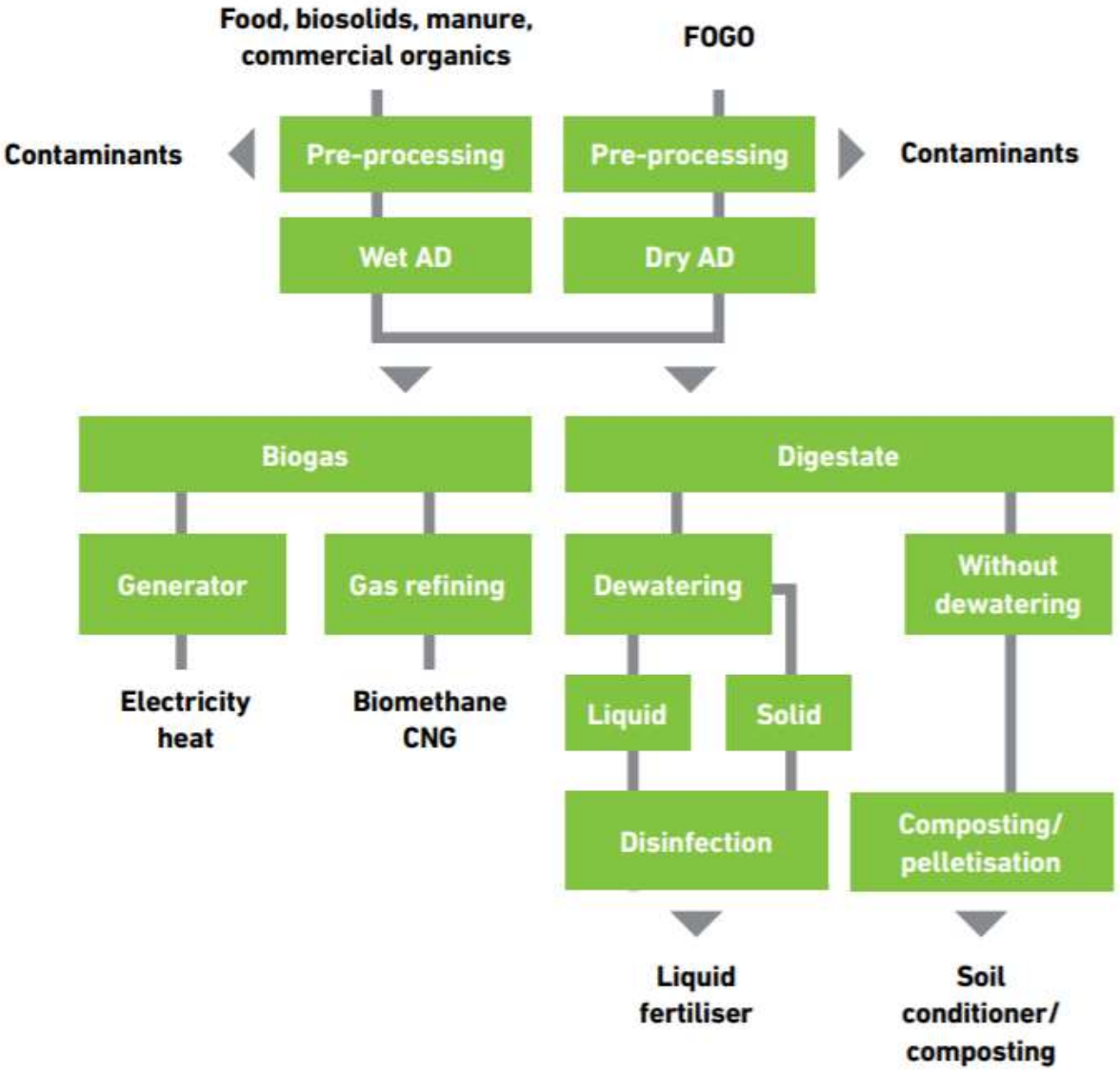


Figure 5 Input and output diagram for AD facilities [20]

3.3.1 Low solids (wet) AD

Low solids AD, often referred to as 'wet' AD, is a treatment option for food waste that produces biogas and a liquid product by-product, known as digestate. An example of wet AD facility operating in WA is the Richgro facility at Jandakot. This facility processes commercial food wastes to produce biogas, which is used to produce renewable electricity. Liquid digestate is understood to be used as an input to production of nutrient-rich compost. The facility also has a mechanised de-packaging and feedstock preparation facility and can receive packaged food waste, including plastic bags, as well as bulk loads of solid and liquid commercial food waste.

[19] Sustainability Victoria. 2018. RRE007 Guide to Biological Recovery of Organics (sustainability.vic.gov.au)
[20] Sustainability Victoria. 2018. RRE007 Guide to Biological Recovery of Organics (sustainability.vic.gov.au)

Although wet AD is well suited to processing readily solubilised organic wastes, it is not suited to feedstock containing high proportions of fibrous and slow to degrade woody lignocellulosic materials, such as stems and branches present in garden organics, and is therefore not suitable for FOGO processing without significant feedstock preparation and pre-treatment.

3.3.2 High solids (dry) AD

High solids AD, often referred to as ‘dry’ AD (typically operating at greater than 30% solids content) is better suited to FOGO than low-solids AD processes as they can typically accommodate garden organic waste in the feedstock. Some, though not all, dry AD processes may require addition of structure material, such as woodchip, to maintain some porosity to allow recirculation of process water during digestion.

Thermophilic (high temperature) AD processes operate in the temperature range of 55 to 58 degrees Celsius and achieve pasteurization of digestate during the anaerobic processing. Mesophilic (middle temperature) AD processes operate in the 35 to 38 degree temperature range and digestate from these AD processes may require a subsequent pasteurization step, depending on end use.

There are currently no high solids AD facilities commercially processing FOGO waste in Australia, however the technology is common and well established in Europe and is being increasingly deployed in North America.

3.4 Organics processors (WA)

Table 6 lists organic processors currently operating in locations relevant to the Perth and Peel regions, as well as the processing technologies they currently use or are in the process of establishing, and their ability to process FOGO/FO.

Table 6 Significant organic waste processors in the Perth and Peel region

Name	Current Situation	Current facility type	Products currently produced	Approved for FOGO
Richgro (Jandakot and North Bannister)	Not processing FOGO Mostly GO and commercial organics. Producing liquid digestate from commercial FO at Jandakot AD facility.	Wet AD Facility Windrow composting New large-scale windrow composting operation in development at North Bannister (Culford Agriprecinct)	Liquid digestate from AD. Will consider using as an input to their composting process to produce a range of compost, soil blends and soil conditioners. A range of composted mulches and soil conditioners to relevant Australian Standards, including bagged products for retail sale. Not currently selling FOGO-derived product.	✗
Bunbury Harvey Regional Council (Dardanup)	Products currently produced from Banskia Road site.	Uncovered mobile aerated static pile composting.	BHRC produce FOGO-derived composts that are tested for compliance with AS4454, and have 'organic' certification. Main client base is understood to include: Certified organic farmers Intensive Agriculture Extensive Agriculture Urban and Amenity users Environmental remediation requirements (internal) Rehabilitation Local Government BHRC have "organic certified" compost accreditation by ACO Ltd.	✔ (moving to Stanley Rd)
Bunbury Harvey Regional Council (Australind)	Not yet operating	In development – will be in-vessel (tunnel) composting, 35,000 tpa initial capacity, provision for future increase to 50,000 tpa	No markets yet established (see Dardanup facility) Works approval to construct IVC facility for FOGO and mulching facility for GO	✔ (future site)
C-Wise (Nambeelup)	Not processing FOGO. Mostly GO and commercial organics.	Uncovered mobile aerated static pile composting.	A range of composted mulches and soil conditioners to relevant Australian Standards.	✗
Go Organics (Boonanarring)	GoOrganics are new to FOGO and recently completed a FOGO processing trial. Mostly GO and commercial organics. Not currently processing FOGO.	Works Approval granted for infrastructure upgrades to allow processing of up to 8,000 tpa FOGO waste. Hardstand extension not yet completed.	A range of composted mulches and soil conditioners to relevant Australian Standards, including bagged products for retail sale. Not currently selling FOGO-derived product.	✔ (future)
Nutrarich (Brookton) .	Not processing FOGO	Open windrow operation	Not currently selling FOGO-derived product.	✗
SUEZ (North Bannister)	FOGO, Works Approval granted. Not currently processing FOGO waste.	Open windrow operation. FOGO waste processing is planned and FOGO transfer	A range of composted fine soil conditioners to relevant Australian Standards.	✔

Name	Current Situation	Current facility type	Products currently produced	Approved for FOGO
	Only processing GO.	station with 100,000 tpa capacity is in development at Bibra Lake	Not currently selling FOGO-derived product.	
SMRC (Canning Vale)	Receive FOGO waste at Canning Vale facility and prepare for composting by contractor (off site)	FOGO waste decontamination, preparation and transfer facility.	Not selling FOGO-derived product.	✗
EMRC (Red Hill)	Currently undertaking limited trial at Red Hill site collected from 2 of 6 member councils; Bassendean (since Aug 2020) and Bayswater (since March 2021). New permanent FOGO processing facility currently in procurement with 60,000 tpa initial capacity, expandable to 100,000 tpa. May include AD and/or IVC technology.	Temporary FOGO processing facility – open air uncovered piles with mobile aerated floor system, and odorous air drawn off to a modular biofilter. Up to 10,000 tpa FOGO processing currently licensed.	EMRC are new to this process. Total quantity circa 10,000 tpa FOGO waste collected. Market development in progress. No established markets/customers for FOGO-derived products to-date.	✔
Purearth Woottating	Contracted to process up to 15,000 tpa FOGO waste from SMRC. SMRC delivers prepared (screened and shredded) FOGO to Purearth for composting.	Windrow composting	Understood to be currently selling blended products incorporating FOGO-derived products to urban amenity customers (landscaping soils) including wholesale customers, as well as mulch-based composted blends incorporating FOGO-derived content to broadacre farmers. Boutique composts from non-FOGO inputs also and used in FOGO-derived product blends.	✔

3.4.1 Views and lessons learnt from consultation

From research and stakeholder consultation, the following views and observations were identified:

- Current approved facilities may not meet revised standards (per draft Guideline: Better practice composting, when finalised) and may require additional approvals and associated asset and infrastructure upgrade.
- Some processors are already, or may ultimately end up, locked into contracts at set gate fees, which constrain expenditure on process and infrastructure upgrades and do not contain appropriate provisions for managing feedstock contamination variance.
- It is considered by some existing processors to be too expensive to upgrade their processes to effectively deal with the contaminants in FOGO feedstock. This type of additional processing can make the end product too expensive to get to a standard they can sell to their existing end markets/customers.
- Processing to manage contaminants and product transport cost vs proximity to market are important challenges to balance and ultimately solve.
- Several processors are already upgrading their operations/licences and seeking relevant approvals to process FOGO material in the future.

4. Recycled organic products

Below is a description of different products that can be produced from FOGO feedstock and an indication of market output and demand in WA, based on market research.

4.1 Compost products

- Compost (AS4454)
- Soil conditioner (added to soil to improve structure by increasing aeration, water holding capacity, and nutrients)
- Mulch (a surface treatment used as a protective soil cover to control temperature, contain weeds and improve water retention).
- Soil blend (AS4419) (an organic soil blended with for example bark, compost, sand, loam)
- Pellets or granules

Compost is made from the controlled biological decomposition of organic matter, in the presence of oxygen.

Quality compost is considered an excellent soil conditioner and source of major plant nutrients, including readily available potash (potassium). Compost is not the same as ‘potting soil’ or other media used for container grown plants, but compost can be used as an ingredient in manufacture of potting soil mixes (to AS3743).

It should be noted that FOGO is not typically used to produce a coarse mulch, but instead generally screened to produce a composted soil conditioner or input to a range of soil amendment products.

4.2 Anaerobic digestion products

End products from AD are listed below:

- Biogas, which can be used for heat and/or electricity or further processed into renewable natural gas (RNG) or compressed natural gas (CNG/biofuel)
- Liquid digestate (from wet or dry AD)
- Solid digestate (from dry AD)

Digestate can be composted to achieve pasteurization, controlling weed seeds and pathogens, and to reduce odour.

4.2.1 Biogas (renewable energy, fuel)

It is possible to convert biogas to electricity or heat. The biogas can also be upgraded to biomethane (purified biogas >97% methane with minimal contaminants) or compressed natural gas. Biomethane can be injected into the gas distribution grid, or used as vehicle fuel to offset consumption of fossil fuel. This can reduce greenhouse gas emissions (GHG) by up to 95% relative to using diesel/petrol.

Biogas can also be converted to electricity using internal combustion engines or microturbines to power on-site infrastructure or be exported to the electricity grid. These processes incur additional cost.

4.2.2 Digestate (liquid and solid)

An AD process may produce a liquid digestate which may be sold, depending on regulations (noting that the proposed end of waste framework and waste derived material determinations, when implemented, may impose conditions around this). An option can be to further process liquid digestate to produce a dried pelletised fertiliser, soil conditioner or blended product. This process is utilised at the Earthpower food waste AD facility at Camellia in NSW to produce prills (small balls or round pellets) that are sold to a wholesaler for incorporation in blended fertilisers. Dry AD generates a solid digestate that can be composted on site and subsequently sold as a composted soil conditioner.

4.2.3 Biosolids containing products

Co-processing of FOGO wastes with municipal biosolids (sewage sludge) is not a widely adopted or established practice. Although FOGO feedstocks have sometimes been proposed to be mixed with biosolids in either wet co-digestion or dry AD and subsequent in-vessel composting processes. Adding biosolids to the compost means that additional undesirable substances such as PFAS, microplastics and heavy metals may be introduced to the resulting compost, constraining end uses. Biosolids have been found to contain varying concentrations of synthetic organic compounds and metals, including arsenic, cadmium, chromium, lead, mercury, nickel and selenium.[21]

The above challenges limit the types of end markets that a co-processed FOGO/biosolids-derived product could be directed to, and the practice of combining these materials for co-processing is therefore not recommended.

4.3 Current FOGO processing capacity

To assess the current volume of FOGO-derived products being sold to the market in WA, information provided by organics recyclers via the online survey, as well as interviews with processors, has been set out below. Survey responses were received from a cross-section of the industry but not all processors responded to the survey. Processors were also reluctant to share details of tonnages processed citing concerns around commercially sensitive information and confidentiality. The information presented in is therefore known to be incomplete, so an overall estimate has been made to indicate current volumes of FOGO derived products.

It is also important to note that FOGO processing is still quite new in the WA marker context, and quantities collected for processing are still quite modest in a national context.

[21] WMR. 2019b. 'The state of biosolids in Australia and the US'

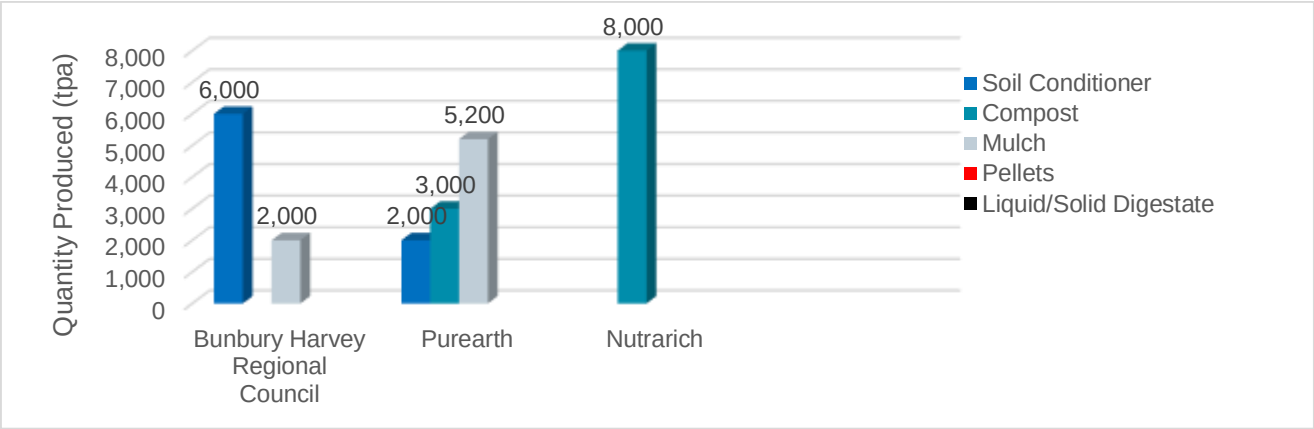


Figure 6 Responses from online survey (confirmed via stakeholder consultation)

According to the survey, the FOGO-derived materials are typically being blended with other materials as a component of various FOGO-derived products.

Below is an overview how the percentage of FOGO-derived material contained in products manufactured for sale.

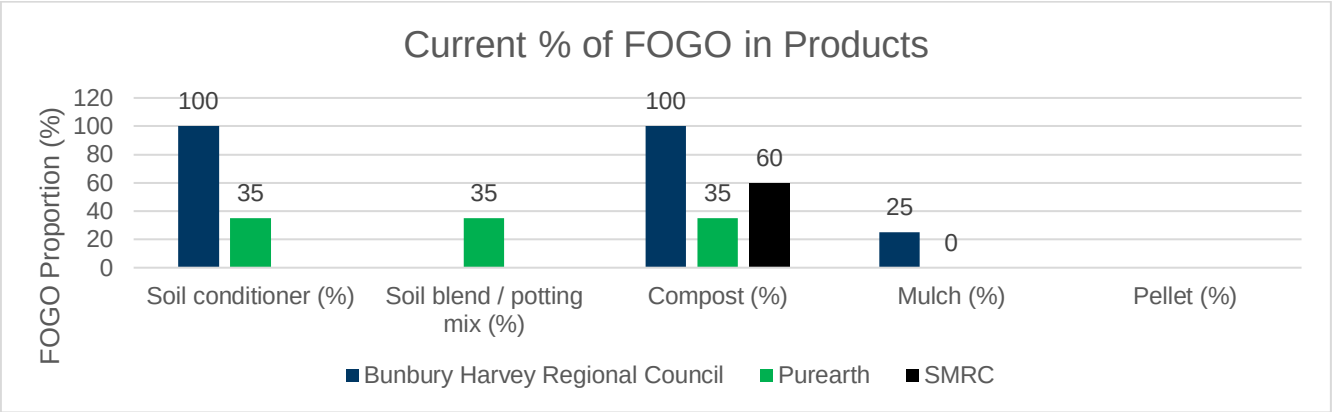


Figure 7 Indicating percentage of FOGO-derived material in FOGO-derived products

Below is a summary of the types of recycled organic products generally produced in WA, indicative market value ranges and typical markets sold into, based on industry consultation.

Table 7 Overview of recycled organic products sold in WA currently

Product	Produced in WA	Current market values (estimated) $/t	Markets sold into	Key FOGO product
Compost to AS4454 (market aligned)	Yes	$0-$80	Agriculture, Urban amenity, Local Government Parks and gardens	Yes
Uncertified compost	Yes	$0-$20	Remediation, Mining	Possible
Soil conditioners and soil blends	Yes	$40-100	Urban amenity, Households, Remediation	Yes
Potting mixes	Yes	$80-120	Urban amenity, Households	No
Digestate Solid	Not yet produced	N/A	Same as for compost products[22]	Possible

[22] Assuming digestate is composted before sale, in the absence of clear policy and regulatory guidance, and local market precedent.

Product	Produced in WA	Current market values (estimated) $/t	Markets sold into	Key FOGO product
Digestate Liquid	Yes	N/A	Same as for compost products, subject to policy[23]	No
Compost pellets	Yes	From $600 [24]	Agriculture, Urban amenity, Local Government Parks and gardens	Yes

The online survey found 67% of Local Government respondents would be willing to pay something for FOGO-derived products, but not more than $60 per tonne.

Concerningly, a significant proportion indicated they would only be interested in using FOGO-derived products if they did not have to pay anything for the product. This is inconsistent with the core principles of a circular economy, given the FOGO waste collected for processing is essentially 'generated' by Local Government.

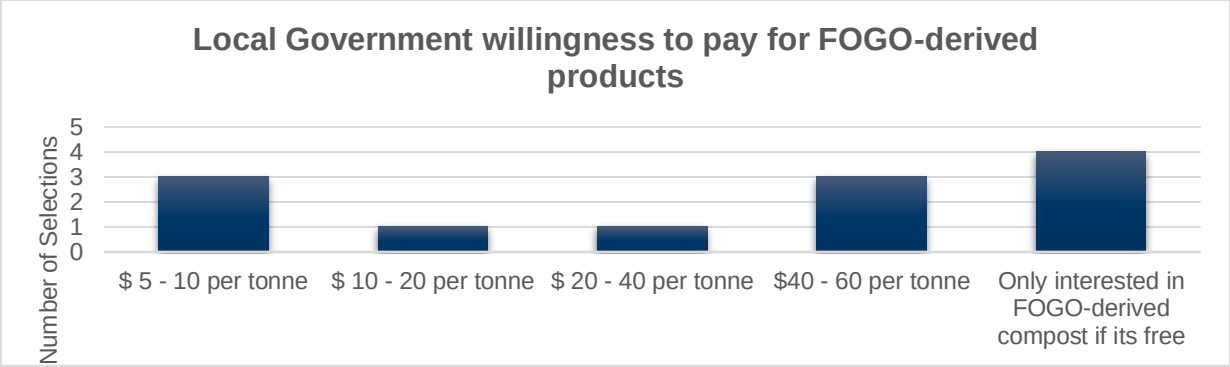


Figure 8 What Local Government is willing to pay for FOGO-derived products (online survey responses)

All other end markets (agriculture, remediation etc) are less willing to pay and suggested $10-20 per tonne.

4.4 Competition from established products

Organics recyclers will not only produce FOGO-derived products, but also products from commercial FO, commercial and municipal GO, and organic wastes from other sources (e.g. biosolids, manures, crop residues).

Additionally, synthetic fertilisers that are mass produced and used in accordance with long-established usage guidance, often at a cheaper price (per hectare) and delivering a predictable plant growth response, will compete with FOGO-derived products.

FOGO-derived products are not expected to directly compete with other recycled organic products in the same markets but will likely instead be inputs to a range of blended, amended and value-added products. It is important that FOGO-derived products find a place in the market where they can be sold at an affordable price and create sustained market demand, at a quality standard that is appropriate to the market segment they are sold into.

Land application of biosolids (sewage sludge) as a soil amendment is well established in broadacre agriculture in WA. Repeat applications can result in an excess of nutrients such as nitrogen, phosphorus and magnesium and a rise in pH which, over time, may prove detrimental to crop nutrition balance and also cause weed problems. In experience overseas (UK), biosolids appeared to be initially successful at weed suppression, although in later months it appeared to encourage the growth of particularly aggressive weed species.[25]

[23] Currently in WA, there is some uncertainty around regulatory policy for use and sale of digestate
[24] Various industry sources; compost pellets and granules are currently manufactured in WA in limited quantities. Prices vary. An example was cited at $675/t (excluding GST) ex-works Perth metro. Delivery extra.
[25] WRAP. 2021b. Landscape and Regeneration: Compost Case Studies

Synthetic fertilisers are man-made and often manufactured from fossil-based energy sources including natural gas and various mineral composites. They can contain a wide variety of macro and micro-nutrients including ammonium nitrate, ammonium phosphate, superphosphate and potassium sulfate. They are generally less expensive to manufacture and apply than natural fertilisers. The reason why synthetic fertilisers are popular to use it that they can release their nutrients into the soil very predictably and are often highly soluble, leading to rapid nutrient release, but also limited persistence in the soil profile, which can lead to contamination of groundwater and nutrient enrichment of surface waters.

Long term use of synthetic fertilizers can also reduce populations of beneficial soil microorganisms that convert residual plant and organic matter into nutrient-rich stable organic matter like humus and readily absorbed plant growth promoting substances. Excess nitrogen from synthetic fertilizers can also leach into groundwater and surface water, leading to water pollution and algal growth, without improving soil structure.[26]

Table 8 highlights key attributes of various products relevant to market development of FOGO-derived products.

Table 8 Competitive products

Competing product	Description	Competitor to FOGO-derived products
Chemical (synthetic) fertilisers (with pesticides, herbicides etc)[27]	Synthetic fertilisers are well established, proven to provide predictable yields/plant response and easy to use with established practices and equipment available; release nutrients rapidly	HIGH. Lower cost per hectare, but long-term value not preserved (in soil).
Raw animal manures and litter	Applied as fertiliser - can improve soil structure (aggregation) improving nutrients and water retention, and improving fertility	MODERATE. Price competitive and nutrient/fertilising value-driven
Soil amendments (clay, loam, peat, aglime)	Natural soils and mineral supplements used to improve soil structure, restore pH balance	LOW. Not a direct competitor. May be used with FOGO-derived products.
Biosolids – land application	Biosolids are the end product from sewage treatment; known to contain heavy metals and other contaminants, including PFAS	MODERATE. Requires compliance with WA Biosolids Guidelines 2012
Mulch (pasteurised and non-pasteurised)	Mulch products made from recycled organics (including GO) - sometimes used instead of compost/fertiliser and may be cheaper than FOGO-derived products	MODERATE. Generally (should) be applied as surface treatment - not incorporated into topsoil
Compost derived from separate FO and GO streams, other inputs	Produced from commercial food waste collection and GO	MODERATE. Directly comparable, potentially lower contaminants. May be certified to higher standards

4.5 Lessons learnt

Lessons learnt from research and stakeholder consultation:

- Alignment of policy and regulatory frameworks, supply chain and production systems that encourage quality end products such that market alignment and incremental growth are achieved.
- Products need to be produced to specifications and standards that are market appropriate, to build trust and enable end users to understand long-term benefits of soil building with recycled organics.
- If products offered are of appropriate quality, end users are willing to pay a reasonable price for those products.
- FOGO-derived products should not seek to compete with other recycled organic products but instead find a niche where they are best suited to an application, or supplement other products.
- There are available a number of end markets available to direct FOGO-derived products towards.

[26] EnviroIngenuity. 2018. (www.enviroingenuity.com)
[27] Research Solutions. 2007. Accessible, cost effective, habitual use

- Markets will likely absorb the anticipated quantities of FOGO-materials as long as long as quality is appropriate to the market being accessed and benefits are understood by end users.

5. Regulations, quality control and assurance

5.1 Overview of regulatory framework

Australia's current regulatory framework for organics recycling is inconsistent across all jurisdictions. The Federal government has indicated support for the implementation of FOGO across all jurisdictions, and developing national waste policies and setting targets (e.g. National Waste Action Plan). The actual implementation of policy settings and regulatory controls and directives are delivered at a State Government level, cascading down to Local Government laws and by-laws.

Below is a list of national policies and the regulatory framework that is driving and supporting the development of FOGO from national/federal level:

Table 9 National policy, regulatory and funding framework relevant to FOGO

Category	Policy
Organic Strategy, Waste Legislation directives	2018 National Waste Policy: Less waste, more resources National food waste strategy, National Waste Policy Action Plan A Roadmap for reducing Australia's food waste by half by 2030 National Soil Strategy - Food Waste for Healthy Soils Fund Recycling and Waste Reduction Act 2020 and Recycling and Waste Reduction Bill 2020
Energy/emission	Emission Reduction Fund Australian Carbon Credit Unit (ACCU) generation (e.g. source separated organics methodology) Renewable Energy Target scheme
Funding	**Federal Budget 2021-22:** $11.0 million to support Australia's recycling industry, including further funding for the National Product Stewardship Investment Fund and support for the Australasian Recycling label to help consumers recycle properly. The Government is investing $67.0 million to enhance organic waste facilities and support community education to reduce the amount of food waste going to landfill. **National soil health strategy.** The National Soil Strategy sets out how Australia will value, manage and improve its soil for the next 20 years. The strategy highlights three overarching goals: (1) prioritise soil health, (2) empower soil innovation and stewards and (3) strengthen soil knowledge and capability. A fund of $67M until 24/25 to support diversion of household and commercial food and FOGO from landfill to soil via the expansion of existing FOGO processing infrastructure and capacity. **Stop Food Waste Australia:** The Minister for the Environment launched Stop Food Waste Australia in December 2020, which will play a key role in delivering the National Food Waste Strategy to halve Australia's food waste by 2030. **Climate Solutions Fund:** eligible methodologies under the *Carbon Credits (Carbon Farming Initiative) Act 2011*, including the 'Measurement of Soil Carbon Sequestration in Agricultural Systems' methodology determination (2018), which will provide financial incentives to the agricultural sector to apply organic amendments to increase soil carbon. Authorised ACCUs are currently sold via government auctions, however, the Clean Energy Regulator is looking to establish an online 'carbon exchange platform' for the purpose of trading ACCUs[28]. It is likely that certifications will be established for the agricultural sector in the future, to enable farmers to use ACCUs to claim 'carbon neutral certification' for their produce. The Source Separated Organics Methodology enables eligible organic waste diversion projects to generate ACCUs for sale over the life of the project. **ARENA** Funding support for renewable energy projects

[28] Clean Energy Regulator. 2021. Media release: Developing an Australian carbon exchange (www.cleanenergyregulator.gov.au).

5.1.1 Federal funding support for WA FOGO project

In May 2021, the deputy Prime Minister and Minister for Infrastructure, Transport and Regional Development Michael McCormack announced that as part of the Australian Government's continued commitment to fund projects that will help drive regional Australia's recovery from COVID-19, $6 million in funding support had been awarded towards a new garden organics compost facility at the Bunbury Harvey Regional Council's Stanley Road facility. This will support Western Australia's South West to create jobs, economic stimulus and opportunities to help drive the region's recovery from COVID-19.

5.2 Policy and regulatory framework

5.2.1 Western Australia

The State government (WA) regulatory and policy framework is supporting FOGO implementation through development of strategies, policies and funding initiatives. Key elements include:

- Western Australian Climate Policy
- WA Waste Avoidance and Resource Strategy 2030
- Energy emission Strategy
- Waste Infrastructure, FOGO, End market application guidelines (Government)
- Funding schemes, Grants (Government)
- Local authority Waste and Recycling Local Laws (as applicable)
- Licensing, compliance, environmental planning (EPA WA)

5.2.2 Other States and Territories

Below is an overview of the different frameworks and policies that are in focus around FOGO in each jurisdiction.

Table 10 Regulatory framework and strategies relating to FOGO in other jurisdictions

FOGO focus (by state)	Overview
New South Wales	
Special focus in the State	NSW has a strategy for delivering net zero emissions by 2050. EPA and has previously supported the organics recycling industry with grant funding for new recycling infrastructure and contamination removal/management. Waste levy in Sydney metropolitan area currently is $147.10 per tonne and in Regional Levy Areas $84.70 per tonne, with annual CPI increases.
NSW EPA (regulator), Market development grants	NSW has rigorous requirements for resource recovery orders/exemptions (to extinguish waste levy liability on recovered resources) - costly to obtain and maintain; not seen as an ideal model for other jurisdictions to emulate. Ripple effects on market investment confidence following NSW EPA MWOO ban[1] given that these restrictions do not apply to biosolids, and some contaminants of concern are known to be present in other organic waste streams. Grants to introduce FOGO services, new FOGO processing facilities and to increase market for compost, support new markets for compost to improve agricultural land. Food scraps campaign, increased capture rate with 10% growth understood to be mostly driven by FOGO rollout.
NSW EPA	Waste Levy framework and a system of Resource Recovery Exemptions and Resource Recovery Orders, as well as Compost Order (2016)
FOGO progress	NSW has over 50 FOGO collection services rolled out.[29] Market barriers are considered to relate to market awareness and attitude, competition from inorganic substitutes, regulatory

[29] Amanda Kane, Manager Organics, NSW EPA

FOGO focus (by state)	Overview
	requirements and risks: Growth end market areas are considered to be agriculture and mine rehabilitation.[30]
Queensland	
Special focus in the State	Queensland's new Waste and Management and Resource Recovery Strategy encourages the development of a circular economy and has identified food waste as a priority waste stream. Following the introduction of a ban on single-use lightweight single use plastic shopping bags (July 2018), and the introduction CDS scheme in 2019, Queensland is now introducing a ban on single use plastic items on 1 September 2021.
Department of Environment and Science, DES (regulator) QLD Resource recovery 2019	Under Queensland's waste to bio futures fund, food waste is identified as a priority waste stream. Grant funding is available for reprocessing initiatives through RRIDP[31] and Food Rescue grants. Although Queensland re-introduced a levy on landfilling of commercial wastes in July 2019, the scheme ensures Councils are advanced 105% of their levy liability calculated based on their previous year's landfilled waste tonnage (adjusted for population change). Queensland's effective 'zero-value' levy on municipal wastes (to-date) has not been conducive to implementing all-in GO and progression to FOGO in Queensland and is seen by many as a major commercial impediment to viable FOGO rollout in Queensland.
FOGO progress	Organic Action Plan in development and soon to be released by DES. Singe use item plastic ban will be introduced on the 1st of September 2019. Waste levy, increasing to $85 per tonne on 1 July 2021, (and currently only applicable to commercial wastes) is scheduled to increase to $90 per tonne in July 2022. The state has one vegetarian FOGO collection service rolled out in Ipswich (opt-in user-pays with very low participation rates). Processing cost for composting is very low, however it is understood that organic waste processors do not currently have commercial margins sufficient to incorporate adequate contamination management processes (resulting in production of low-quality end products that cannot be sold to agriculture sector).
Victoria	
Special focus in the state	The state is progressively rolling out FOGO services, and has developed reports and guidelines to lead the development of organic waste diversion and processing. Collaborative procurement (State purchasing policy for recycled products), Grants for investment facilitation, and clear regulatory and policy guidance has been developed. Sustainable procurement (LGA's as major end user). Education is being flagged as a benefit. Waste (landfill) levy currently $65.90 per tonne in metropolitan Melbourne, increasing to $125.90 in July 2022.
Sustainability Victoria and EPA VIC (regulator).	Released key documents Developing sustainable markets for recycled organics (2017) as a key priority and developing guidelines for producing higher quality products via development of product profiles / specifications. Recycled organics market analysis 2019: Research and development (fit for purpose product for agriculture), Working with existing agricultural networks to promote and grow markets (acknowledged to be slow). Applying market structure where supply is not linked to demand and highlighted this requires an overflow option. Create regionally based production facility for overflow. Build urban amenity market via quality standards, and education, and marketing. In the process of developing and implementing an 'end of waste' framework based around Waste and Resource Recovery Determinations (currently in consultation).
FOGO progress	Over 40 FOGO collection services implemented. Recently encountered an issue with persistent herbicides found in recycled organic composts (from GO) in 2020.[32] Recycling Victoria's market development priorities: (1) product stewardship, (2) research and development, (3) develop and promote standards, specifications, and guidance materials. Sustainability Victoria is working with government and industry to improve quality of recycled organics (both pre & post processing), and improve consolidation and aggregation of recovered materials to support growth in manufacturing[33]
South Australia	
Special focus in the state	Green Industries South Australia (GISA) is a statutory government body that the State has been committed to driving the transition to a Circular economy around organics for over 10 years.

[30] NSW EPA. 2020. NSW Organics Market Analysis - Growing markets for quality organics products.
[31] Resource recovery industry development program | State Development, Infrastructure, Local Government and Planning
[32] Victoria EPA. 2021. EPA puts compost operation on hold. (www.epa.vic.gov.au)
[33] Sustainability Victoria. 2020. Market Development Guide.

FOGO focus (by state)	Overview
	GISA has supported investment in infrastructure and collection systems that help to reduce FO waste. The state recently implemented a single use plastic item ban in 2020 (expected to help reduce plastics contamination in organic waste collected for recycling) and SA is committed to becoming a carbon neutral state by 2050.
GISA (Green Industries South Australia) and EPA SA(regulator)	Green Industries provides grants to support transitioning to a circular economy (encouraging net zero emission), is developing a new Food Waste Strategy; currently in draft (2021), and recently produced an economic assessment of the impact a circular economy could have on the State
FOGO progress	The State has over 20 FOGO collection services rolled out.[34] Market demand for FOGO-derived products is considered to be higher than the tonnage that is being produced in SA.[35] SA introduced a single use plastic ban in 2020 and many FOGO services accept compostable packaging in their feedstock. The most common type of kerbside organic collection service is fortnightly FOGO collections. Waste levy recently increased to $143/tonne in metropolitan areas and $71.50/tonne in non-metropolitan areas.
Tasmania	
Special focus in the State (State Government)	Waste infrastructure and State Organic Waste Strategy currently being investigated and is expected to be released in 2021/22 financial year. Circular economy is an important element of the proposed strategy. Tasmania is introducing a waste levy in November 2021 at $20 per tonne with scheduled increases to $60/tonne over the next four years.
EPA TAS	Committing to Net Zero Emission by 2050. Lightweight plastic shopping bags are banned in Tasmania. Reduce volume of organic waste sent to landfill by 25% by 2025.
FOGO progress	The state is committing to FOGO, is to introduce a waste levy and currently has 4 Councils operating a FOGO service.
Northern Territory	
Special focus in the Territory (NT Government), EPA NT	No GO kerbside recycling, though self-hauled GO is recycled at Darwin's Shoal Bay – currently relatively low volumes. No FOGO Services. No landfill levy applies.
ACT (Canberra)	
Special focus in the Territory (ACT Government), EPA ACT	The ACT wants to achieve net zero emissions no later than 2050 and ensure that 100% of its electricity comes from renewable sources. No organic waste diversion initiatives have been released to-date, and residents are offered a GO collection service only (currently no FOGO service). A landfill (waste) levy has been proposed but not implemented and it is understood the proposed levy will only apply to commercial (non-residential) waste customers.

5.2.3 Key regulatory barriers and lessons learnt

The key policy and regulatory barriers and lessons learnt that have constrained adoption of a broader suite of organics recycling technologies, and consistent market growth for recycled organics in Australia are:

- Selective use of AS 4454 as a regulatory compliance standard when this was not the intended scope and purpose of this voluntary standard
- Lack of policy framework to encourage the Councils to introduce Organic collection services that produce feedstock with low contamination rates
- Lack of policy framework and standards for use of digestate (from AD) as organic fertiliser – low solids digestate generally treated as controlled waste (most states)
- Industry concerns over potential future liability for contaminants in recycled organics products (e.g. microplastics, phthalates, PFAS)
- Inconsistencies between regulatory constraints for recycled organics vs inorganic fertilisers (not just WA)
- Waste levy frameworks are not consistent across states; no 'model' system exists
- End of waste frameworks still in development in some states

[34]. Green Industries SA. 2020. Valuing our food waste: SA's strategy to reduce and divert household and business food waste 2020-2025
[35] Jessica Wundke, GISA. March 2021.

- NSW, Victoria and SA have all been progressively been rolling out 3-bin collection systems and GO -> FOGO progression, ramping up landfill diversion
- Waste levies can, if implemented service to drive implementation of FOGO services

6. Contamination of FOGO-derived products

When discussing contaminants in the FOGO stream it is important to understand the differences and potential sources of those that derive from the FO component and those associated with GO, which are therefore not unique to FOGO.

Pre-emergent and selective herbicides have become more important for the control of grass weeds, particularly annual ryegrass, in the past decade as resistance to post-emergent herbicides has increased. Some selective broad-leaf weed killing herbicides also contain active constituents that are not degraded through composting. Several new biodegradable herbicides have recently been released for domestic lawn grass weed control, with consumers becoming more aware of the environmental implications of certain active ingredients.

In the household FO stream, the most common contaminants are packaging around outdated food and take away containers.

Common contaminants, some of which are incorrectly placed in FOGO bins, and others being incidental contaminants, found in FOGO waste collected from households are:

- Glass (glass bottles, jars)
- Plastics (beverage containers, non-compostable bags, shrink wrap, packaging, single use plastic items, plastic coated paper items like disposable cups, plates, plastic items)
- Metal items (beverage containers, food tins, lids off bottles and jars)
- Herbicides and herbicide residues (from contaminated grass clippings, weeds)
- Treated wood (off-cuts, shavings, sawdust from preservative treated and engineered timbers)
- Heavy metals (dry cell batteries, treated timbers)
- Diseased and/or pest affected garden waste (e.g. pathogens)

The characteristics of all recycled organic products, including FOGO-derived products, need to be considered in the context of their intended end market. This is usually managed by the processor when manufacturing particular blends and products for specific applications, however, risks also need to be evaluated by end users before applying them on land.[36] All farms are likely to have (or should consider developing) a biosecurity plan that includes measures designed to protect the property from the entry and spread of pests, diseases and weeds.

Table 11 highlights the contaminants “of most concern” to key market segments as indicated during stakeholder consultation. It was found that weeds, pathogens and chemical contaminants are a greater concern to the broader market than physical contaminants, which end users assumed would be managed to an acceptable quality standard in FOGO-derived products prepared for sale.

Table 11 Market tolerance for contamination

	LG - Parks and gardens	Road development (major projects)	Mine rehabilitation	Extensive agriculture (cereal and livestock)	Extensive agriculture (forestry)	Intensive agriculture (grazing)
Weeds	✗	✗	✗	✗	✗	✗
Disease (e.g. pathogens)	✗	✗	✗	✗	✗	✗

[36] Agriculture Victoria. 2021. Compost and farm biosecurity

	LG - Parks and gardens	Road development (major projects)	Mine rehabilitation	Extensive agriculture (cereal and livestock)	Extensive agriculture (forestry)	Intensive agriculture (grazing)
Plastic	✗	Undesirable but some tolerance	✗	✗	Undesirable but some tolerance	✗
Glass	✗	Undesirable but some tolerance	Undesirable but some tolerance	✗	Undesirable but some tolerance	✗
Chemical contamination	✗	Some tolerance	✗	✗	✗	✗
Heavy metals	✗	Some tolerance	✗	✗	✗	✗

6.1 Contaminants of concern

Municipal organic waste streams can be a source of both physical and chemical contaminants. Contaminants are any non-compostable items in the organics waste stream. The types of contaminants in organics recycling feedstocks fall into three broad categories, being: physical chemical and biological. The extent to which contaminants are a concern in recycled organics products is generally a function of the source of the feedstocks, the level of contaminants in the feedstocks, the processing to which the material is subjected, quality management and testing protocols, and the target market for the product/s.

Although there have been examples of certain physical and chemical contaminants of concern being present in recycled organic products, further work may be needed to characterise the extent to which these contaminants may impact the suitability of FOGO-derived products for their intended markets.

Detailed assessment of specific contaminants, product characterisation, risk assessment and mitigation strategies were beyond the scope for the current study. There are a range of strategies that have been shown to be effective in managing various contaminants in municipal organics streams in other jurisdictions, but whether these strategies are necessary or appropriate in a WA context, and the extent of key risks and controls that may need to be implemented requires further research. However, some key considerations relevant to FOGO-derived products are outlined below.

6.1.1 Physical contaminants

According to AORA, the single greatest issue facing the organics recycling industry is the contamination of feedstocks, overwhelmingly by plastics. Other contaminants include glass, metals, treated timbers, and persistent chemicals which do not readily break down in the composting process (or in nature).[37]

There are numerous inorganic physical contaminants that are often incorrectly placed in the FOGO bin by householders and can be present in varying proportions in the FOGO waste collected from kerbside. These include plastics (hard and soft), glass and metals, textiles, household hazardous waste, electronic waste (E-waste), engineered and treated timbers and other building rubble.

Community education to highlight the importance of appropriate source separation, and to minimise contamination, is critical to achieving cost-effective processing and minimising the level of physical contaminants in the final product. The need for community education and consistent messaging is ongoing, and there have been numerous examples of Councils achieving physical contamination rates of less than 1% (by mass) on a consistent basis.

Managing physical contaminants in the FOGO waste bioconversion process, however, requires a combination of physical and mechanical intervention post-collection to remove contaminants within the process and in product refining, and may also involve blending with other ameliorants such as sand, clay or other composted products to produce market appropriate FOGO-derived products.

[37] AORA. 2021. Vision 2031: The 10 year Roadmap for Australia's World Leading Organics Recycling Industry.

6.1.2 Chemical contaminants

Chemical contaminants can be present in a variety of waste streams and the sources of these types of contamination in municipal FOGO can include plastic packaging, plant matter (e.g. weeds and their seeds, diseased vegetation), lawn care products (non-biodegradable herbicides and pesticides) and incorrectly disposed physical contaminants (e.g. E-waste and household hazardous wastes).

It is known that the pesticide bifenthrin, which is often tested for alongside the standard analysis suite of AS4454-2012 (albeit not specifically listed as a requirement), has been found to be consistently near or even in excess of the maximum allowable concentration for unrestricted use in FOGO-derived composts in WA and other states. Its presence in the FOGO stream may result from use of ant and lawn grub and beetle control products in residential lawn maintenance and introduced to FOGO waste via lawn clippings.

6.1.3 Biological contaminants

International experience with biological pathogens from meat and meat by-products entering the livestock food chain (CJD/BSE) led to regulation excluding meat and meat by-products from recycled organics processing, or a requirement for thermal treatment to inactivate biological contaminants; for example the European Union animal by-products regulations (ABPR)[38].

Other biological contaminants of concern in organics sourced from municipal garden organics can also include plant diseases, insect pests, weed seeds and plant propagules.

These and other pathogens are generally effectively managed through appropriately controlled composting processes, where pasteurisation is achieved, although some can require extended duration and/or further elevated temperatures for elimination.

6.1.4 Understanding the significance of contaminants in FOGO

Recent publicity surrounding the detection of a persistent selective herbicide (clopyralid) in recycled organics produced from garden wastes in Melbourne have highlighted the need for vigilance and further research to identify source of contamination, risks and mitigations. This research could then inform appropriate management of chemical contaminants in recycled organics generally, including municipal FOGO wastes.

It is understood that the cost of testing for contaminants not currently listed in the suite of analytes in AS4454 can be prohibitive.

Contaminants that have potential to be present in organics streams directed to composting processes could include the following:

- Clopyralid and other persistent herbicides
- Persistent pesticides, such as bifenthrin
- Dieback and other diseases or pathogens (e.g. phylloxera, myrtle rust, neither of which are yet in WA)
- Per- and polyfluoroalkyl substances (PFAS)
- Phthalate esters (plasticisers in plastics)
- Microplastics

It is important to note that the occurrence and significance of the presence (and concentrations) of these contaminants, if present at all, is not well understood and further research is needed to understand whether or not the above and any other contaminants are cause for concern in municipal organics streams generally, and not just in the FOGO waste stream.

It is understood that the cost of testing for certain contaminants can be prohibitive. It is therefore considered that routinely analysing and characterising FOGO-derived products for the presence of any of the above contaminants is beyond the financial capacity of individual processors and if investigation is proposed, it should be undertaken on an industry-wide basis, with funding support from Government.

[38] European Commission, Food Safety. Accessed from: https://ec.europa.eu/food/food/animal-products_en

6.1.5 Available controls and mitigation strategies

Feedstock contamination can be reduced through a combination of ongoing community education supporting positive behavioural change, consistent messaging to householders, stronger product stewardship and extended producer responsibility models, and improved processes and systems.

Other measures may be necessary to reduce the problems associated with single-use and non-compostable plastics, as well as persistent chemicals that are replaceable (with biodegradable alternatives) or able to be eliminated from the supply chain impacting FOGO recycling, through government intervention. Managing the primary sources of these contaminants is beyond the sphere of influence of local government and organics processors.

In a 2019 report commissioned by Queensland Department of Environment and Science[39], it was noted that "*further work is needed to establish the suitability of the AS4454/ Biosolids organic contaminant limits to the current situation with respect to organic waste recycling. Most of these chemicals have been phased out for many years and studies overseas show that they are usually virtually absent in compost products. Conversely, there are numerous contaminants not included in these standards which could be relevant. The NEPM Soil Health Investigation Levels provide a more contemporary and comprehensive list of contaminants that should be considered, although the actual thresholds should be tailored to suit the application of compost to land (rather than the assessment of existing contamination, as the current HILs are designed for).*"

It was also noted that "*In regulating physical impurities, area-based assessment of impurities should be considered as a superior method (compared to weight or item number-based measures) to better account for highly visible light weight impurities such as film plastics, which are likely to break down into microplastics over time*."

6.1.6 Suggested actions

It is important that the Market Development Strategy identifies key issues including barriers preventing the use of FOGO-derived materials in key markets and recommend actions that should be pursued to develop those markets. These recommendations are expected to inform future work programs.

Suggested actions include:

- Undertaking desktop research into findings around persistent pollutants found in FOGO waste streams and FOGO-derived products internationally and in other Australian jurisdictions.
- Funding to be made available for research into the extent, prevalence and range of concentrations of contaminants of concern found in FOGO-derived products in Western Australia.
- Conducting a risk assessment and identifying suitable mitigations that can be implemented for chemical contamination characterisation and management.

Useful guidance and frequently asked questions on persistent herbicides in composts is provided by the US Composting Council.[40]

6.2 Legislation, standards, testing and guidance

The Australian Standard 4454 Composts, soil conditioners and mulches defines the minimum requirements for recycled organic products to facilitate the beneficial recycling and use of organic materials with minimal adverse impacts on the environment and public health. This Standard verifies organic products used in all market sectors including domestic use, urban landscaping, agriculture, and land rehabilitation as being free of plant propagules and pathogens.

6.2.1 WA regulatory framework and policy context

Establishment and operation of organics recycling facilities in WA are subject to the provisions of the *Environmental Protection Act 1986* and the *Environmental Protection Regulations 1987*. The management of waste and recovery of secondary resources from waste is further governed by the *Waste Avoidance and Resource*

[39] ARCADIS. 2019. Critical Evaluation of Composting Operations and Feedstock Suitability – Phase 2- Contamination.
[40] US Composting Council. n.d. Persistent Herbicides FAQ.

Recovery Act 2007 and *Waste Avoidance and Resource Recovery Regulations 2008*. Relevant also are the *Waste Avoidance and Resource Recovery Levy Act and Regulations* (both 2008), which established the framework and instrument for enacting the WA waste (landfill) levy.

DWER regulates industrial emissions and discharges to the environment through a works approval and licensing process, under Part V of the *Environmental Protection Act 1986* (EP Act).

Industrial premises with potential to cause emissions and discharges to air, land or water are known as 'prescribed premises' and trigger regulation under the EP Act. Prescribed premises categories are outlined in Schedule 1 of the *Environmental Protection Regulations 1987*.

The EP Act requires a works approval to be obtained before constructing a prescribed industrial premise and makes it an offence to cause an emission or discharge unless a licence or registration is held for the premises.

In October 2019, DWER released a discussion paper: Modernising the *Environmental Protection Act*. This process is understood to be ongoing and will involve amendments to the EP Act and subordinate legislation.

In February 2020, DWER released a consultation paper 'Review of the waste levy' seeking input on improving the waste levy. The waste levy applies to the landfill disposal of waste generated in the Perth metropolitan area. It increases the cost of landfill disposal, which provides a financial incentive to decrease the quantity of landfill disposal. The Waste Strategy 2030 includes a headline strategy to review the scope and application of the waste levy to ensure it meets the objectives of the strategy.

In May 2020, DWER also published the consultation draft of the Guideline: Better practice composting to provide environmental performance objectives and minimum standards for the construction and operation of composting premises regulated under Part V of the *Environmental Protection Act 1986*. The guideline also defines 'better practice' for composting facilities in relation to the Waste Strategy 2030.

In September 2020, DWER released a discussion paper: Waste not, want not: Valuing waste as a resource, and sought feedback on a proposed legislative framework for waste-derived materials, with submissions closing in December 2020. The proposed legislative amendments are intended to provide certainty around when waste-derived materials are no longer waste, meaning that licensing under the *Environmental Protection Act 1986* would not be required (for example, when applying waste-derived materials to land) and waste levy requirements would not be triggered where relevant.

Implementation of this proposed 'End of Waste' framework is intended to support the Waste Strategy 2030 by encouraging use of waste-derived materials to build confidence in recycled products, increase their demand and develop relevant markets while protecting the environment.[41] The legislative framework remains in development.

The WA Department of Primary Industries and Regional Development (DPIRD) has developed high level general guidance information and advice targeted towards farmers and the agriculture industry on best practices on how to incorporate recycled organics. Information is provided on the DPIRD website (Organic food & farming | Agriculture and Food).

6.2.2 Standards, testing and guidance

According to a February 2020 report by AORA comparing the Australian Standard for compost with similar Standards abroad, there are four methods compost manufacturers to demonstrate compliance to the Australian Standard:

- Product Certification (Third Party Assessment) The manufacturer's capability to produce a product consistently to the Standard is assessed on an ongoing basis by an independent third-party certification body.
- Quality System Certification (Third Party Assessment) The manufacturer's quality management system is assessed against one of the international standards that describe models for quality assurance (AS/NZS ISO 9001 to 9003).
- Customer - Supplier Assessment (Second Party Assessment) A purchaser of a product may wish to assess a supplier to ensure that the product they buy meets their particular requirements. This would be a commercial arrangement between purchaser and supplier.

[41] DWER. 2020: Waste not, want not: Valuing waste as a resource: Discussion paper

– Self-Declaration (First Party Assessment) The manufacturer declares that the products and/or production methods meet recognised standards. The manufacturer can state on labels and brochures that a product complies with the relevant standard, but since it is not a 'third party assessment', no recognisable symbol such as the Standards logo can be applied.

Given the absence of consistent and specific regulatory guidance across jurisdictions, it is likely that the method most commonly used in Australia to-date is Self-Declaration.

Australia has several national voluntary standards relevant to defining quality parameters in products that contain recycled organics (including FOGO products). The most relevant Standards are listed below and these have been discussed and addressed during stakeholder consultation in development of this Strategy.

Table 12 Standards relevant to recycled organic products in Australia

Name of Standard	Description
AS4454: Australian Standard for composts, soil conditioners and mulches (AS4454-2012)	The industry standard for assessing compost quality. AS4454 describes three product grades: pasteurised, composted and mature compost. Limits are defined for a range of contaminants for products claimed to be suitable for unrestricted use, including reference to the relevant state biosolids guidelines, and for products exceeding these maximum allowable concentrations, usage restrictions may apply in certain applications.
AS4419: Australian Standard for Soils for landscaping and garden use (AS4419-2018).	This Standard provides manufacturers with a set of requirements which will ensure that soils can support plant growth and to give users, such as growers, landscape architects and consumers, assurance of the suitability and quality of soils. This Standard sets out requirements and methods of test for general purpose soils, top dressing, topsoil and landscaping mixes, for domestic and commercial use, supplied in either bulk or bagged lots.
AS3743: Australian Standard for potting mixes (AS3743-2003).	This standard sets quality and specification requirements for potting mixes. This Standard specifies physical, chemical, biological and labelling requirements for potting mixes packaged for retail sale. Potting mixes of both regular and premium quality are covered. Requirements are also included for mixes labelled as suitable for African violets, bulbs, hanging baskets, seedlings, orchids, acid-loving plants and plants that are sensitive to phosphorus. The objective of this Standard is to provide manufacturers, educational institutions, consumers and growers with a set of requirements which will ensure that potting mixes can germinate seeds, grow seedlings, strike cuttings and maintain plant growth.
AS6000: Australian Standard for Organic and biodynamic products.	This standard sets out the minimum criteria to be met by operators, before products can be labelled as ‘organic’, ‘biodynamic’ or ‘in-conversion’ or any of these. Those products include unprocessed products from plants, animals, fungi and their processed derivatives.
The Freshcare Food Safety & Quality Standard is an industry owned standard	Procedure and risk assessment around how to apply compost. The Freshcare Program meets the requirements of a wide range of customer groups[42] The standard is achieved through independent third-party auditing to the Standard by auditors working for approved Certification Bodies.
EcoHort EMS Certification	The environmental management system for Australian nursery production Nursery & Garden Industry Australia (NGIA) in partnership with Horticulture Australia Limited (HAL) have developed a set of guidelines that provide a systematic approach for production nurseries to assess their environmental and natural resource management responsibilities. EcoHort is the industry specific set of guidelines or Environmental Management System (EMS).
Soft infrastructure Audit	When and audit and investigation is undertaken to determine the socio-economic benefits around using FOGO derived (or Recycled Organic Products).
Organically certified: There are also organic certification schemes in Australia for example:	**NASAA (National Association for Sustainable Agriculture Australia Limited**). NCO is recognised nationally and internationally as Australia’s pre-eminent organic certification organisation that enables and supports global market access. NCO is Australia’s most credible organic certifier. NCO Certified Operators gain access to organic markets in Australia and around the world including the regulated organic markets of China, USA, Europe, South Korea, Switzerland and Japan.

[42] Freshcare Ltd. 2019. Food Safety & Quality Standard Edition 4.1

Name of Standard	Description
	AOS (Australian Organic Standard)[43]The majority of organic products sold in Australia carry the Australian Certified Organic BUD Logo. The BUD reassures consumers that all the product ingredients have been certified to the Australian Certified Organic Standard and have met rigorous certification checks.

The Commonwealth Department of Agriculture, Water and Environment (DAWE) is currently reviewing all of these standards, in conjunction with locally applied standards in different jurisdictions, with the objective of identifying potential to streamline the standards, testing regimes and policy framework surrounding them.

DAWE is undertaking this project as the lead facilitator for FOGO collection implementation for all Australian jurisdictions. It is understood that with this research they aim to investigate and identify how well the current standards are able to serve the commercially viable development of recycled organics markets, including FOGO-derived products[44].

Figure 9 below shows the most preferred standards currently applied by organics processors, as indicated via the online survey conducted in support of developing the WA Market Development Strategy for FOGO-Derived Products.

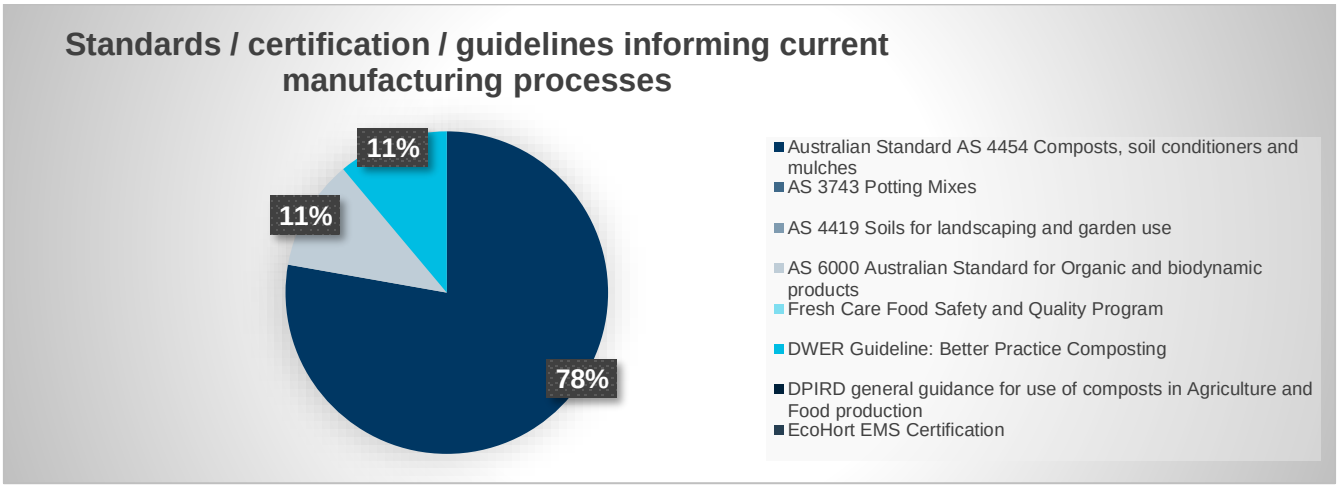


Figure 9 Standards most relevant to organics recycling operations incorporating FOGO

The survey indicated that the most relevant, useful and widely applied standard for FOGO-derived products is AS4454, which is described in more detail below.

6.2.3 Australian Standard 4454 - international benchmarking[45]

The Australian Standard for composts, soil conditioners and mulches (AS4454 – 2012) is a voluntary standard. Testing of compost products against some or all of the quality parameters in AS4454 is entirely at the discretion of individual compost producers, as there is no legal requirement to do so. It is the key reference for the Australian organics recycling industry when assessing and classifying compost products in terms of quality and their intended use.

Likewise, compost manufacturers can decide whether they want to have any of their products certified through third party (Product or Quality System Certification), second party (Customer - Supplier Assessment) or first party (Self-Declaration) assessment. The same approach applies for the associated standards for Soils for Landscaping and Garden Use (AS4419 – 2018) and Potting Mixes (AS3743 – 2003).

AS4454 provides minimum requirements around the properties of composts, soil conditioners and mulches in order to facilitate the beneficial recycling and use of compostable materials with minimal adverse impact on the environment and public health. It is the benchmark standard for compost quality in Australia and specifies minimum processing standards for the elimination of pathogens and weeds. It also sets out reporting requirements

[43] ACO. 2019. Australian Certified Organic standards (aco.net.au)
[44] Stakeholder interview with DAWE, March 2021.
[45] Biala and Wilkinson. 2020. International Comparison of the Australian Standard for Composts, Soil Conditioners and Mulches (AS4454 – 2012).

and a range of analytical tests for both pasteurised and fully composted products that are claimed to conform to AS4454.

The sampling and analysis framework of AS4454 – 2012 includes:

- Minimum requirements for physical, chemical and biological product properties, which provide assurance for users that certified products are free of viable plant propagules and will not cause adverse effects if used appropriately.
- Ensuring that products certified to AS4454 – 2012 quality requirements also comply with State or Federal chemical and organic contaminant guidelines for products suitable for unrestricted use in land application of products derived from organic wastes, compostable organic materials or biosolids, whichever is the more restrictive.
- Limits contaminants and pathogen reduction requirements (see list in Table 13 below). These are aligned with the NSW Biosolids Guidelines for unrestricted use of Grade A biosolids products but allow higher copper and zinc concentrations where this can be justified by agronomic considerations and where none of the other metal limits are exceeded. The new Queensland End of Waste Code Biosolids (QLD Department of Environment and Science, 2019) followed this lead for Grade A biosolids products that can be used without restrictions. WA has its own Guidelines for Biosolids Management (DEC, 2012).
- Differentiates products and minimum quality requirements according to product maturity (pasteurised product – composted product – mature compost) and particle size distribution (soil conditioner – fine mulch – coarse mulch), and in that way defines nine broad product types.
- As a voluntary standard, AS4454 – 2012 does not differentiate between various contaminant classes and allowable uses and does not in itself place restrictions on use. This means the compost can be used everywhere except for home lawns International Comparison of AS 4454 - 2012 10 and gardens.

AS4454 requires testing for the following categories as listed in Table 13, noting that certain other elements may require testing for certain markets, in line with the requirements of the WA Biosolids Guidelines.

Table 13 Contaminants and pathogens to be tested per AS4454

Impurities	Pathogens	Heavy metals	Organic contaminants
Glass, metal, rigid plastics	Faecal coliforms	Arsenic	DDT/DDE/DDD
Plastic – light, flexible or film	Salmonella	Boron	Aldrin
Stones and lumps of clay		Cadmium	Dieldrin
		Chromium	Chlordane
		Copper	Heptachlor
		Lead	HCB
		Mercury	Lindane
		Nickel	BHC
		Selenium	PCBs
		Zinc	

Limitations of AS4454

Based on findings in market research and stakeholder consultation, a number of observations, opinions and perceived limitations with AS4454 were identified:

- More specific and tailormade product standards may be needed to meet expectations of certain end markets, where AS4454 does not provide this level of detail.
- The standard is outdated, it does not test for PFAS, however it does test for contaminants like pesticides that are already banned (i.e. some contaminants need to be added and some need to be removed).

The above ‘perceived limitations’ were considered when developing the WA Market Development Strategy for FOGO-Derived Products. It is important to recognise however, that while the concerns raised are real, the assertions and their implications are not necessarily supported by evidence.

For example, the suggestion that 'levels of chemical contaminants and pathogens are not specified' is incorrect. Clause 2.1 of AS4454-2012 stipulates:

> *"All products shall fully comply with the chemical, physical, organic and pathogen contaminant provisions specified for products suitable for unrestricted use as expressed in the currently applicable federal and state or territory guidelines and regulations for land application of products derived from organic wastes, compostable organic materials or biosolids, or with the provisions of this Standard, whichever is the more restrictive.*
>
> *Where there are no such currently applicable federal and state or territory provisions for composts, soil conditioners and mulches, products shall comply with the list of chemical contaminant upper limit values and the labelling provisions of Tables 3.1(A), 3.1(B) and 3.1(C).*
>
> *NOTE: Non-conformance with this Standard does not indicate that the product may not otherwise be suitable for a range of specified applications that comply with other state or territory government regulations, guidelines, or specified end user requirements. Consequently, it is not appropriate for regulators to specify compliance with this Standard as a mandatory requirement for facility operations, licensing or application to land of production outputs."*

Similarly, the suggestion that 'testing for contaminants like pesticides that are already banned is unnecessary' does not consider the persistent nature of some contaminants in the environment and the existence of legacy chemicals that consumers may have purchased prior to bans being implemented that they may still use in domestic gardens without understanding the implications.

Similarly, whether the existence and concentration of PFAS in composts produced from municipal organics is an issue that warrants routine testing of composts produced (from FOGO for example) is not yet supported by evidence or representative data. The cost of PFAS testing can be significant and therefore characterising representative FOGO-derived products would be necessary to establish whether routine testing is warranted.

It is important that the concerns raised are appropriately considered in progression of actions identified in the Action Plan to be developed in support of the Strategy, to ensure successful development of end markets for FOGO-derived products.

It is possible that many high-level concerns around product quality management and regulatory policy settings will be addressed by the upcoming release of the DWER Guideline: Better Practice Composting.

6.2.4 Comparison of AS4454 and international standards

According to a report commissioned by AORA 2020[46] when comparing the Australian Standard compost AS4454 with international standards, the following observations can be made:

- Contaminant limits in AS 4454 - 2012 and international (European / North American) standards for composts and digestates do not vary markedly for 'regular' compost. Abroad, very few countries have set limits for organic (chemical) contaminants in compost and more organic (chemical) contaminants are tested for under AS4454 - 2012 than in all other standards.
- The legal / regulatory status of compost quality criteria specified in European countries is often very different to the situation in Australia, as is the way in which regulations and quality management and quality assurance schemes are integrated into the regulatory framework.
- Most European countries identify and tightly control which feedstocks can and cannot be composted and therefore largely avoid having to deal with the issue of organic (chemical) contaminants in compost products. Some countries therefore do not require the measurement of organic (chemical) contaminants in compost and digestate when they are derived from source-separated materials.

The report also noted:

"*maximum contaminant concentrations for unrestricted use of biosolids (Grade A) and compost (AS4454) are lower by factors between two and twenty… shows that Australian authorities are more cautious in their assessment of risks associated with the use of biosolids and compost.* and

[46] Biala and Wilkinson. 2020. International Comparison of the Australian Standard for Composts, Soil Conditioners and Mulches (AS4454 – 2012).

"*the 2012 version of the Australian Compost Standard stipulated contaminant limits that are closely aligned to limits stipulated in the NSW Biosolids Guidelines for unrestricted use.*"

6.3 International review and lessons learnt

Countries including Italy, Sweden, UK, Scotland, Canada and Germany have well-established collection services and processing methods for FO and GO, and provide valuable insights on how to successfully produce organic-derived products which meet market expectations for product type, quality and consistency.

Table 14 provides a summary of how each country is managing residential organic waste, including collection services, processing technologies and key markets. As shown, the majority are collecting organic material in separated streams (e.g. GO and FO) instead of FOGO. AD processing is also popular for all countries except Scotland, which is likely due to standards which have been developed by these countries for products produced specifically from AD facilities, as well as guidance on how to apply these end products back into soils.

Table 14 International technology and collection benchmarks

Technology/Innovations	Italy	Sweden	UK	Scotland	Canada	Germany
Open Windrow	Yes	Yes	Yes	Yes	Yes	Yes
Wet AD	Yes	Majority	Yes	X	Yes	Yes
Dry AD	Yes	Yes	Yes	X	Yes	Yes
FOGO collections	No	No	Some	Yes	Some	Yes
Separate FO & GO collections	Yes	Yes	Yes	Yes	Yes	Yes
End market agriculture as well as urban amenities	Yes	Yes	Yes	Yes	Yes	Yes

6.3.1 Italy - high diversion and high market demand[47]

Lessons learnt from Italy, shared by Zero Waste Europe network, are outlined below.

Italy processes and composts around 7 million tonnes FO and GO every year. Italy and Germany are considered to generate the most compost products from organics across Europe. Italy largely prefers dedicated FO collections with more frequent collections (2-4 times per week). The key driver for this approach is cost savings; the smaller vehicles are more economical and waste capture rates are maximised. Residents place their food waste into small buckets that are hand-picked by collection staff. The EU is soon to introduce a mandatory requirement for separate FO and GO collections.

In Italy, digestate must be post-composted to meet the end-of-waste standard. For this reason, most AD facilities accept compostable and paper bags. Compostable packaging can be co-composted (or co-digested) and co-collected, provided it's certified under the EN 13432 standard, which defines the minimum requirements packaging has to meet in order to be processed by industrial composting. When using dry AD processing technologies (e.g. BEKON and AIKAN) there is no need for specific management of compostable packaging however, wet AD processing technologies require 'floating rejects' to be admixed to the final composting stage.

Despite the ability of an AD facility to manage compostable packaging, Zero Waste networks and environment non-government organisations (NGOs) continue to discourage their use. Compostable plastics potentially encourage residents to dispose of other contaminants in their organics bins (e.g. non-compostable bags, tea bags, coffee capsules, food contact packaging etc). There is a concern that a widespread application of compostable items would make organic waste bulkier, collection more expensive, and burden processors with the additional cost of removing or breaking down these materials to produce a clean end product[48]. The EU is a strong advocate for reducing and reusing plastics, rather than replacing traditional plastic packaging with compostable plastic

[47] Enzo Favoino, 2019, Scientific Coordinator, Zero Waste Europe, Scuola Agraria del Parco di Monza
[48] Enzo Favoino. 2019. Zero waste strategy fundamentals: It always starts with organic waste (www.zerowasteeurope.eu)

packaging. Contamination levels in FO (and GO) waste are typically close to 2%, but can be as high as 5% in more populated areas (e.g. Milan).

Italy uses a stringent (national and EU) compost standard to build market trust in recycled organic products. The standard limits physical impurities to 0.5%, and potentially toxic elements including cadmium (<1.5 mg/kg) and zinc (<500 mg/kg).

6.3.2 Germany (FOGO) - strict standards and AD processing[49]

Lessons from Germany, shared by representatives of Remondis Australia Pty Ltd.

Germany has strict regulations, standards and certifications which provide effective guidance for organics processors on how to produce quality managed end products that are market ready. While complicated, the framework provides a sense of security, as the industry understands what is required.

A key piece of legislation is the “Bioabfallverordnung“ BioAbfV - nichtamtliches Inhaltsverzeichnis (gesetze-im-internet.de) a Bio-Waste-Regulation framework. This regulation applies to facilities processing FOGO, GO or other organic wastes (but not residential FO). The whole waste supply chain is regulated under this framework including, processing, pasteurization, mixing, analysis, quality criteria, and application of end products to land. It is very strict and consistent.

Through “Bioabfallverordnung” processors have the option of joining a Quality Management Association, the largest is called “Bundesgütegemeinschaft Kompost“ (Startseite (kompost.de)). Members are assessed on their quality management program (via audits and analyses); those who meet the assessment criteria can apply a quality assurance label to their products (example shown right).

Biosolids are regulated separately to other organic waste streams[50]. Assuming these regulations are met, processors are permitted to compost biosolids and apply the end-products to land. The trend in Germany is to burn biosolids, however, processors still have to recycle the phosphorus (apply it back on land).

Commercial FO (collected from restaurants, canteens and kitchens) also has its own separate regulation. The regulation is based on EU animal by-products legislation. It includes waste from abattoirs and dead animals. The regulation requires that food waste is pasteurised for at least 1 hour at over 70 degrees Celsius. Commercial FO is usually processed in AD facilities which include a pre-treatment stage for pasteurisation. Separate regulations apply to wet AD or co-digestion (e.g. Bioabfallverordnung).

Biogas, an end product of AD, is traditionally used to produce electricity and heat. However, in the last ten years there has been a shift with processors upgrading AD facilities from biogas to biomethane which can feed back into the electricity grid. REMONDIS has initiated a project to use biogas as biofuel to run waste collection trucks.

6.3.3 Sweden - reduce emissions and return nutrition to soil[51]

In 2005, Sweden introduced a ban on landfilling organics and by 2024 the provision of source-separated FO collections will be a mandatory requirement for all Councils.[52]

[49] Information shared via email by Organics manager, Remondis Australia
[50] https://www.gesetze-im-internet.de/abfkl_rv_2017/AbfKl%C3%A4rV.pdf
[51] Information shared by Elin Hagberg, Head of Municipal Division Uppsala, Sweden
[52] Municipal management in Sweden< European Environment Agency, Feb 2013

Sweden also legislates targets for the conversion of food waste to biogas (to reduce the country's net GHG emissions), as well as targets for the conversion of food waste to products that are applied back to land.

A standard developed for digestate from AD (SPCR 120), was introduced in 1999 to take into account the whole waste supply chain from feedstock to end product. The standard requires that processing facilities apply regulations relating to food safety which define acceptable (low) levels of heavy metals and toxins in end-products[53]. Feedstocks can include residential FO and GO, commercial FO (collected from restaurants, canteens, kitchens, groceries stores), and commercial GO (including nurseries). Biosolids and mixed general waste are excluded. SPCR 120 requires third party audits to achieve certification.

Sweden has also developed an online profit calculator, which is free and publicly available to end users. The calculator relies on users to enter site-specific information (e.g. soil characteristics and nutrition, product type, application method and rates, crop type etc). The resulting output provides an indication of profits that could be derived from applying recycled organic products to their soils.[54]

6.3.4 United Kingdom - risk assessment and contamination controls

Lessons from the UK were shared by representatives from West London Waste Authority, Waste and Resources Action Programme (WRAP), Zero Waste Scotland and the Wales Government. [55]

The United Kingdom (UK) introduced residential food waste collections in 2003 / 2004. Today both FO and FOGO collections are used, however, FOGO collections are generally more for rural areas and are being phased out in England and Wales. FOGO collections have been more successful in Scotland, compared with England, Wales, and Northern Ireland.

Food waste is mostly processed using in-vessel composting facilities (IVC) or wet/dry AD. In the UK, gate fees for AD facilities are approximately 50% lower than for IVC.[56] Wet AD facilities can be designed with filters to remove physical contaminants (plastics, glass etc), noting they are not suited to FOGO due to the GO component being less amenable to liquefication.

The UK, similar to Sweden, also has an online profit calculator for applying recycled organics.[57] Key end markets in the UK include agriculture, rehabilitation and remediation.

To overcome market perceptions around the quality and consistency of recycled organic products, the UK environmental regulators (led by WRAP):

- Recognise 'end of waste' approaches for compost delivered under the Compost Certification Scheme (CCS)
- Developed a suite of compost standards, such as PAS100, for compost and digestate products
- Prepared a risk assessment which identifies how to apply compost products back to soil.

UK (PAS 100[58])

The CCS requires all compost to meet the requirements the PAS100 'Publicly Available Specification' owned by the British Standards Institution. The standard specifies minimum requirements for compost quality, with compliance audited by a third party. Compliant sites must operate a Quality Management System based on HACCP (Hazard Analysis and Critical Control Points) principles to ensure that the required quality is consistently delivered.

[53] SPCR 120 - Biogödsel (biogodsel.se)
[54] Stallgödselkalkylen - Greppa, www.greppa.nu
[55] Information by Dr Andy Reed (Head of Waste Strategy, Wales Government), Nina Sweet (Specialist adviser, WRAP), Emma Beal (Managing Director, West London Waste Authority), Alison McKinnie (Project manager Organics, Zero Waste Scotland)
[56] WRAP. n.d. Organics.
[57] WRAP. 2021. Compost Calculator.
[58] Zero Waste Scotland. n.d. Compost safety for agriculture.

To apply this standard, waste feedstocks must be biodegradable, and source separated. To compost FO, additional approval is required from the Animal and Plant Health Agency (APHA).

Composting processes normally include a high temperature (>65°C) sanitisation phase that lasts several days. This sanitisation phase is a legal requirement where FO is composted, under the Animal By-Products Regulations (ABPR).

PAS100 provides baseline limits for contaminants known to be present in compost, including, potentially toxic elements (such as zinc and chromium), pathogens (*E. coli* and *Salmonella*), and physical contaminants (such as metal and plastic). Certified composts are not considered wastes, however, ABPR still regulate grazing by livestock on pastures where FO-derived composts have been applied.

Risk assessment

In the UK, BSI PAS 100 specification for compost and AD digestate has been widely adopted. However, despite this, end-users continue to raise concerns around the quality, safety and usability of recycled organic composts applied to land for cereal and livestock production (including for meat consumption) (BSI, 2011). In response to this, WRAP initiated a 'Confidence in Compost' program to identify, understand and address stakeholder concerns. This resulted in the development of three comprehensive risk assessments tailored to key product types and end uses:

1. Green compost used on land where livestock are grazed, or fodder grown
2. Green/food compost used on land where livestock are grazed
3. Green and green/food compost used on land where crops are grown for human consumption.

The result from these risk assessments demonstrated to the agricultural market that compost is safe to use according to current regulations and guidelines.

Zero-Waste Scotland

Zero-Waste Scotland are a not-for-profit environmental organisation, funded by the Scottish Government and European Regional Development Fund. One of their strategic objectives is 'maximising value from waste'[59] achieving their vision of a circular economy for Scotland, where products and resources are used responsibly. Scotland has an ambitious target to reduce its food waste by one third by 2025[60].

The Guideline: *Food waste management in Scotland* (Scottish Environment Protection Agency (SEPA)), provides guidance to the industry on best practice management for recycling food waste. Stakeholders are encouraged through disincentives (fines) to meet the requirements of this guideline. Fines can be in the order of £300 to £10,000[61]. SEPA have also released a statement that lays out the duty of care throughout the supply chain.[62]

Zero-Waste are currently working with Local Governments to reduce contamination in organics feedstocks. They advocate for product manufacturers to reduce packaging, to alleviate the need to pre-sort organic waste to mechanically remove packaging (contaminants).

In 2019 Zero-Waste investigated contaminants in food waste and found that plastics are the biggest contaminant in food waste. Key recommendations (from the report[63]) were as follows:

- Councils should provide compostable caddy liners to households where food waste is actively composted
- Train composting site staff to recognize caddy liners
- Introduce a consistent approach in terms of providing compostable caddy liners for residential food waste collections
- Develop a Scotland-wide education program

[59] Zero Waste Scotland. 2021. Our Corporate Plan. https://www.zerowastescotland.org.uk/about-us/corporate-plan
[60] Zero Waste Scotland. 2021. Scotland's Food Waste Reduction Action Plan. https://www.zerowastescotland.org.uk/food-waste/reduction-action-plan
[61] Scottish Environment Protection Agency (SEPA). 2016. SEPA Guidance: Food waste management in Scotland.
[62] SEPA. 2016. Duty of Care statement.
[63] Scottish Environment Protection Agency (sepa.org.uk)

- Developed targeted education to address common 'in bag' plastic contaminants (e.g. cucumber films, fruit stickers)
- Develop a food waste feedstock monitoring program. This could be overseen by a trade body (as in Italy) or become part of the regulatory framework (e.g. through a site license or permit condition). For example, in California minimum inspection and monitoring requirements are mandated.

Wales

WRAP has done extensive trials and research to determine best practice management for organics recycling.

The 99% of households in Wales with separate FO collection essentially have the same system – a kitchen caddy, liners and an outside 25 litre bin. Proving a kitchen caddy and liners makes it easier for householders to control contamination. Fifteen of the 22 Local Authorities collect FO in the same vehicle as other co-mingled recycling (which is kerbside sorted). The vehicle has nine compartments to accommodate the separate waste streams. This approach has been found to reduce transport costs and associated emissions.

In Wales, all AD facilities are wet AD processes and do not incorporate composting maturation. The plastic caddy liners are removed at the front end of the AD process and are incinerated or disposed to landfill. The low levels of contamination are claimed to be a result of good education and manual checking for compostable bags by collection staff.

One of the current challenges with AD processing is that the resulting liquid digestate (as well as GO-derived compost) is not highly valued by end users. There is no problem with market uptake of these products, but product sales do not represent a significant revenue stream, compared with the renewable energy generated. Further work is needed to demonstrate the benefits (cost and other) of these products.

6.3.5 Canada

In Canada most organic waste is collected as separate FO and GO. The colder climate may be a contributing factor, with GO waste only generated in summer and autumn. Canada has strict regulations on end-products that are sold as Fertilizers. As of October 2020, the new regulation T-4-120 – Regulation of compost under the Fertilizers Act and Regulations came into force.[64]

GHD in Canada is currently undertaking a feasibility study on introducing compostable packaging into organic collection schemes. The study will assess:

- How to process the compostable packaging in wet/dry AD facilities
- Cross contamination from the addition of compostable packaging
- Impact of composable packaging on the quality of end products
- Pilot trials and testing protocols.

6.3.6 International key lessons learnt

Key international lessons identified through research and consultation are listed below:

- Strict certifications/standards are applied across the whole supply chain (including feedstock). This produces end products that the market can trust.
- Separate streams generate better end products that suit market demand: even with elaborate processing steps, the use of MSW compost is unacceptable for farmers. It has been shown that quality compost could only be produced if the feedstock material was segregated at source from municipal and commercial organic residues and collected and processed separately.[65].
- Countries that are post-composting digestate into end-products have higher market demand.

[64] Government of Canada. 2020. Guidance Document Repository.
[65] Biala and Wilkinson. 2020. International Comparison of The Australian Standard for Composts, Soil Conditioners and Mulches (AS4454 – 2012).

- Online profit calculators are a tool used in several countries to help end users of recycled organics to calculate their economic benefits.
- Low contamination (i.e. via interventions) is important to invest in to produce high-quality products.
- AD is the most used processing technology as it creates both compost and biogas, largely driven by renewable energy incentives. The AD process reduces overall GHG and contributes towards net zero emission targets.
- Compostable packaging is not widely encouraged and accepted in the feedstock.

7. Markets - existing and emerging

Research undertaken by AORA found the largest markets for recycled organics in Australia in 2017 were agriculture (75%) and landscaping / rehabilitation (19%)[66]. According to AORA, the total demand for recycled organic products in WA is currently approximately 215,000 tonnes per annum.

7.1 Overview of existing and emerging markets

Existing markets for recycled organic products (including FOGO-derived products) in Australia, as reported by AORA, include those listed below:

– **Urban amenity** (52.5%): for use in urban areas including residential and commercial landscaping, retail nursery, special projects (such as road embankments)
– **Intensive agriculture** (26.2%) including viticulture, market gardens, orchards, turf production, nursery production and wholesaling
– **Environmental remediation** (4.1%) contaminated site and soils remediation, water purification and biofiltration uses
– **Rehabilitation** (2.3%) use for landfill cover and rehabilitation, erosion stabilization, land reclamation, restoration, revegetation and rectification[67]
– **Other** (15.0%), including **extensive agriculture** which includes pasture production (livestock including sheep, beef and dairy), broad-acre cropping and forestry.

In comparing the difference between markets for recycled organics in 2007 and the emerging market distribution for FOGO-derived products in 2021, it was apparent that there is currently insufficient representative data and sample size to form a view on market segmentation for FOGO-derived products that would be indicative of future trends. The 2021 market distribution information available was not based on volumes of product purchased, but rather on the ways WA FOGO processors Go Organics, Purearth and Bunbury Harvey Regional Council have ranked the markets they are accessing, in their responses to the online survey. It is expected that the market balance will shift again in coming years as more processors incorporate FOGO into their operations, and emerging markets are developed.

Markets that have been slower to take-up the use of organics, but are likely to have the potential to use large quantities, particularly in the near term, include:

— Extensive agriculture (forestry, broad-acre)

— Rehabilitation (mining, major road/rail projects)

To maintain consistency with the waste hierarchy and circular economy approaches outlined in the *Waste Avoidance and Resource Recovery Strategy 2030,* the conversion of organic waste to energy via thermal processing was not considered further in development of the Strategy. Material recovery through recycling is preferred over energy recovery. It is acknowledged that energy recovery is preferable to landfill disposal but should only be considered for residual wastes (Waste Authority 2019).

[66] WMR. 2019b. Waste management resource, second edition.
[67] Australian Economic Advocacy Solutions. 2020b. Australian Organics Recycling Industry Capacity Assessment.

Five (5) key markets and a selection of sub-markets were identified for further consideration (Table 15). These markets were a focus for targeted consultation, and then ranked through a process of Multi-Criteria Analysis (MCA) (Appendix B).

Table 15 Existing and emerging markets for FOGO-derived products

Market	Sub-market	Beneficial use
Urban Amenity / Landscaping	Local Government (Parks and Gardens)	Garden beds (parks and other) Turf (sports ovals and open spaces in parks and gardens)
	Property development (Major Projects)	Establishing gardens in new residential developments
	Urban amenity (residential)	Household gardens ('buy back' at waste & recycling centres)
Extensive Agriculture	Broad-acre agriculture (cereal and livestock)	Soil amendment
	Forestry	Soil amendment
Intensive Agriculture	Grazing	Soil amendment
	Hemp	Soil amendment
	Turf production	Soil amendment
	Vineyard	Soil amendment, weed suppression, pathogen protection
	Orchards (e.g. olive / citrus / avocado)	Soil amendment, weed suppression, pathogen protection
	Market gardens (flowers, seedlings, vegetables, fruit)	Soil amendment, weed suppression, pathogen protection
Rehabilitation	Local government	Landscaping – road verges/embankments Landfill cover/reclamation
	Mine rehabilitation	Rehabilitation of disturbed land
	Road Development (Major Projects)	Landscaping – road verges/embankments
	Rail Development (Major Projects)	Landscaping – road verges/embankments
Remediation	Local Government	Contaminated sites and soils Water purification/wetlands Biofiltration
	Consultants	

Stakeholder consultation and MCA (Appendix D), identified extensive agriculture (cereal, livestock), mine rehabilitation, and urban amenity (residential, Local Government), as the most promising market opportunities in WA in the near term (to 2025).

7.2 Transport considerations

Transport is a key factor in accessing regional agricultural markets. Whether the organics recycling contractor, a product distributor, or the end user (farmer) arrange delivery of the product, the cost of transport can be a significant challenge to be overcome.

7.2.1 Cost of transport

Transport costs can vary significantly depending on a range of payload-influencing variables including bulk density, vehicle configuration, travel distance and time, as well as route restrictions. Multiple commercial variables

also need to be considered including casual rates vs long-term contract rate efficiencies, availability and the origin location of the vehicle relative to both the processor and end customer locations.

Indicative transport costs are provided in Table 16. As shown, the cost of delivering compost to a market located 200 km from the processing facility may be in the order of $28 to $32 per tonne, subject to adjustment for transport vehicle point of origin, driver fatigue management and a number of other factors. The costs are indicative only and subject to product characteristics, including moisture content, that can significantly alter bulk density of composted recycled organic products, which can have a corresponding impact on transport cost efficiency.

Table 16 Indicative transport costs

Bulk Road Transporter	Gross Combined Mass[68] (tonnes)	Trip Cost ($) / km[69]	Assumed Payload (tonnes)	Cost ($) / tonne (100 km return trip)	Cost ($) / tonne (200 km return trip)
B-Double *(Category 2C)*	68.5	2.80 – 3.00	38	16	32
A-Double Road Train *(Category 3A/4A/5A)*	85	3.20 – 3.40	50	14	28

Higher transport costs generally apply to:

- Casual haulage engagements, relative to long term performance-based contracts
- Short haulage trips (<50km)
- Smaller product volumes or low density loads (i.e. less than the maximum payload for the transporter).

As a point of reference, a compost distributor provided a recent indicative rate of $35 per tonne to transport compost from their Perth metropolitan base to a wheat-belt farming location around 280 km east-southeast of Perth. This rate was based on a recent delivery, with a 54-tonne payload, and backloading via grain/fertilizer trucks (A-double configuration).

7.3 Case studies from national and international trials

A selection of case studies are presented below for markets that are not actively using FOGO-derived products (noting these are not yet widely available in WA), to demonstrate the benefits and provide feedback on suitable product types and application rates identified through field trials.

7.3.1 Extensive agriculture (cereal and livestock)

Trial by MRA Consulting Group[70]

Market: extensive agriculture (cereal and livestock)

Product: pelletised compost

Application method: airseeder

Result: increase in crop yield and profit per hectare

Overview: funding from the NSW Environment Protection Authority's (EPA) Organics Market Development program allowed the establishment of the pelletised compost trial. The aim of this trial was to demonstrate the cost and yield benefits of direct application of pelletised compost by an airseeder.

[68] Main Roads WA. 2020. Operating Conditions – Prime Mover Trailer, Combinations.
[69] Indicative rates, high sided tipper bodies, grain haulage configuration, based on return trip, total kilometres travelled, long-term contract
[70] MRA Consulting Group. 2021. Compost Pellets Down the Tube.

PRODUCT CHOICE AND WHY

One of the potential barriers to developing a market for FOGO-derived products in the extensive agricultural sector is the cost (in both time, labour, and specialised equipment) required to apply organics at scale. The average farm size of an extensive agricultural property in the Western Australia Wheatbelt is 3000 – 4000 hectares, hence, a 'one-pass application' which ties in with existing practice (seeding) is greatly desired by the market. The trial undertaken by MRA Consulting Group demonstrates that an alternative application method exists for this market. In Western Australia organics are currently applied to the soil surface during summer. Applying organics as a pelletised product during seeding would have the added benefit of incorporating these products into the soil profile delivering greater nutritional and other benefits to the seed and soil.

TRIAL LOCATION

The trial was conducted on a broad-acre crop and livestock farm near Bathurst, NSW. The average annual rainfall for this region is approximately 600 mm, with rainfall fairly evenly distributed across the year, with peak monthly falls (>50 mm) occurring from October through to February (Station No. 63291, BoM 2020). Temperatures are mild, with the mean monthly temperature ranging from 12.1°C in July, to 29.0°C in January. The WA Wheatbelt is comparatively warmer in summer and autumn, with daytime temperatures in the order of 30 – 40°C. Annual rainfall is similar in the south-west, decreasing to 250mm further east and north. Noting that the rainfall distribution in the south west of WA is quite different, the climates are similar enough, particularly in the south-west of the WA Wheatbelt, for this product concept to be explored further.

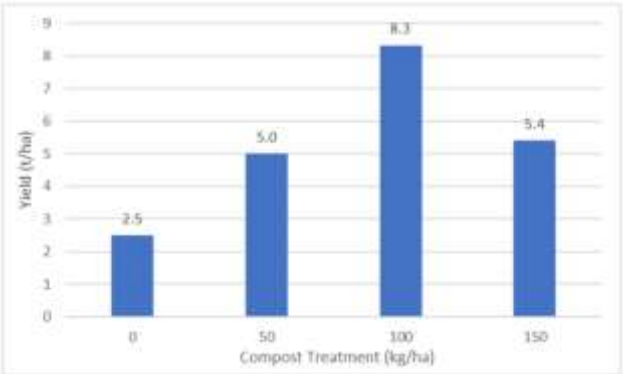
RESULTS

Yield

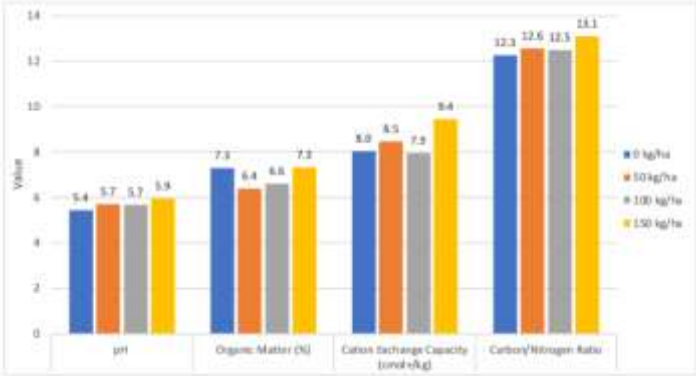
Early plant growth measurements indicated the 150kg/ha treatment was more advanced in its growth compared to the remainder of the crop. The drop off in yield at 150 kg/ha would be due to faster growth, earlier maturity and subsequent peak yield prior to the timing of the trial harvest.

Soil Health

The trial demonstrated that the pelletised product neutralised pH, improved the carbon-to-nitrogen ratio and increased nutrient availability through increased cation exchange capacity.



Yield of triticale by pelletised compost treatment



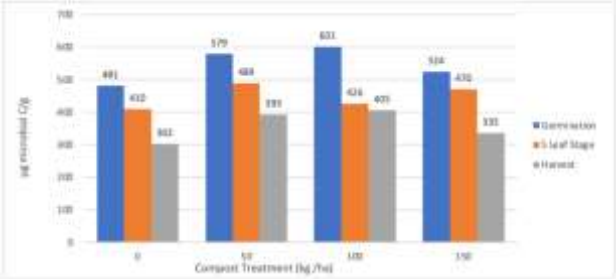
Comparison of top 5 cm of soil from different compost treatments at harvest

Soil Microbial Activity

All compost treatments had higher microbial carbon levels compared to the control, indicating higher microbial activity. Higher microbial activity improves soil health by increasing decomposition, controlling pests and facilitating nutrient cycling. Microbial carbon decreased over the course of the crop lifecycle.

Cost-Benefit Analysis

Pelletised compost is more expensive per tonne than loose compost, but lower application rates are required due to the lower moisture content and direct incorporation into the soil. Moreover, applying pelletised compost using a seeder avoids compost spreading costs in addition to the seed and fertiliser sowing costs. ***Overall cost at recommended application rates is lower for pelletised compost.***



	Pelletised compost	Loose compost
Purchase price ($/t)[71]	450	30
Application rate (t/ha)	0.1	10
Additional spreading costs ($/ha)	0	150
Overall application cost ($/ha)	45	450

OUTCOME

This trial has demonstrated that pelletised compost can increase crop yield and profitability by approximately $1,000 per hectare (based on a sale price of $170/ha for triticale).

Pelletised compost treatment	Overall application cost per ha	Yield (t/ha)	Revenue per ha	Profit per ha
0 kg/ha	$0	2.5	$425	$425
50 kg/ha	$23	5.0	$850	$828
100 kg/ha	$45	8.3	$1,411	$1,366
150 kg/ha	$68	5.4	$969	$902

It was noted that pelletised compost used in the trial was sourced from Peats Soils in South Australia, with inputs being primarily GO and commercial FO. It was further noted that Australian Native Landscapes have since established compost pellet production capability in NSW and pelletised compost product costs are expected to be broadly similar to that noted in the trial summary.[72]

Trial by CarbonAg Solutions[73]

Market: extensive agriculture (cereal and livestock)

Product: pelletised compost (C33)

Application method: airseeder

Result: positive yield response in 58% of treatments in Year 1. Consistent changes in the microbial population structure was observed, in addition to increased levels of soil carbon.

Overview: WA based trials at six Wheatbelt properties. Product testing by the manufacturer to understand the impact and improve the formulation of the new technology.

PRODUCT CHOICE AND WHY

One of the potential barriers to developing a market for FOGO-derived products in the extensive agricultural sector is the cost (in both time, labour, and specialised equipment) required to apply organics at scale. The trial undertaken by Bioscience and Meag Consultancy on behalf of CarbonAg demonstrated that an alternative application method exists for this market.

TRIAL LOCATION

The trials were located in Esperance, Binnu, Kulin, New Norcia, Pingrup and Tammin. A variety of crops were sown, and the trials were supported by a local agronomist. The trials were conducted in 2019, which was a low rainfall season.

[71] Pers comm. Virginia Brunton, MRA Consulting, 24 April 2021
[72] MRA Consulting Group. 2021. Compost Pellets Down the Tube
[73] Carbon Ag. 2020. Trials

PRODUCT	RECOMMENDATION
C33 is a dust free pellet suitable for application through an airseeder made from a proprietary compost from a local compost manufacturer. **RESULTS** Results were positive although hampered by both the poor season in 2019 and the complex design of multiple sites, soils conditions, application rates and crops. C33 was applied at 30, 50 and 100 kg/ha with varying levels of mineral fertilisers also applied. 58% of treatment plots had increased yield with C33. Leaf tissue analysis showed better leaf tissue level of phosphorous and potassium, but lower levels of calcium relative to standard farmer practice. There were universal increases in soil carbon from using C33; the increases were more than can be explained by mass addition. The increases were found to be due to greater root biomass and root exudates along with an increase in microbial biomass.	The final recommendation from the trial was to continue research to aid the development of the product. This product does not include FOGO, however is relevant as it demonstrates that efforts in other parts of Australia to produce and promote pelletised compost products are also underway in WA. The trial made no mention of difficulties with application and focused on the agriculture benefit of this blend. The trial was funded by CarbonAg Solutions. Independent trials that consider the economics of application and transport of pelletised compost products in WA are recommended.

Trial by NSW EPA

Bungendore pasture project[74]

Market: extensive agriculture (livestock)

Product: compost

Application method: applied at the surface (broadcast spreader) and incorporated

Result:

- Improved pasture production (yield and species diversity) and soil fertility (within 3 years)
- Pasture dry matter increased from 23% to 49%
- Stocking rates increased 43% from 100 to 143 head per hectare
- Four-fold increase in available phosphorous
- 50% or more increase in organic matter, carbon, total nitrogen, calcium, copper and boron
- Increase in soil pH.

7.3.2 Extensive agriculture (forestry)

WRAP (2021b[75]) reports that the application of compost is particularly well suited to tree plantings (including coppiced systems) as compost provides slow-release fertilizer and other benefits for a longer timeframe (3-5 years) compared with synthetic fertilizers which are typically applied bi-annually.

7.3.3 Intensive agriculture

Market gardens (flowers, seedlings, vegetables, fruit)	***Capsicum trial[76] – Richmond, VIC*** This trial compared four treatments: - FOGO AS4454 compost	**Soil challenges:** none reported **Treatment:** compost applied once during the crop rotation

[74] NSW EPA. 2018a. Case Study: Bungendore pasture project.
[75] WRAP. 2016. Landscape and Regeneration: Compost Case Studies.
[76] Sustainability Victoria. 2018. Social research: Perceptions of recycled organic products.

	- FOGO compost/slow-release nitrogen blend (10t/ha, 20t/ha and 40t/ha) - Chicken manure - Inorganic fertilizer.	**Result:** - Compost nitrogen blend was most successful - Cost benefits were realised from applying compost once during the crop rotation. **Learnings:** Successful use of FOGO-derived products in the agricultural sector depends on: - Product quality - Developing a customised approach (which may include baseline soil sampling to inform rates of application, compost blended and applied to suit crop/location/soil).

7.3.4 Rehabilitation

Mine rehabilitation using compost[77] ***Bickershaw Colliery (UK)*** **Market:** mine rehabilitation **Product:** compost **Competing products:** paper mill crumb and sewage sludge **Overview:** this trial tested using compost to rehabilitate a brownfield site in Bickershaw Colliery (UK). The final land use was agriculture (short-rotation crops) for the production of renewable energy.	**Soil challenges:** nutrient deficient and acidic **Treatment:** ground limestone and local compost (500 t/ha) **Result:** - Increased potassium (>10x) - Increased phosphorus - Increased plant available water - Outperformed paper mill crumb and sewage sludge - Benefits observed for duration of trial 4 years (one application)
Mine rehabilitation using compost[78] ***St Ninians (UK)*** **Market:** mine rehabilitation **Product:** compost **Overview:** this trial tested using compost to rehabilitate a brownfield site (former open coal mine) in St Ninians (UK). The final land use was agriculture (short-rotation crops) for the production of renewable energy.	**Soil challenges:** nutrient deficient and prone to water logging **Treatment:** compost (300 t/ha and 600 t/ha) **Result:** - Increased organic matter - Increased potassium - Increased phosphorus - Increased magnesium - Increased pH - Benefits observed for duration of trial 3 years (one application)
Mine rehabilitation using FO and GO ***Northumberland (UK)*** **Market:** mine rehabilitation	**Soil challenges:** poor drainage, plant water availability and rooting depth **Treatment:** compost applied via spreading **Result:**

[77] WRAP. 2016. Landscape and Regeneration: Compost Case Studies
[78] WRAP. 2016. Landscape and Regeneration: Compost Case Studies.

Product: FO and GO derived composts (PAS 100 certified) **Overview:** this trial tested using compost to rehabilitate a brownfield site in Northumberland (UK).	- Slow release of nutrients (3-5 years) builds soil fertility and quality over time - Cost-effective method of increasing plant productivity (yields) - Discourage invasive weed species - Food derived compost achieved greater yields with a lower application rate.
Roadside rehabilitation using compost ***Bedfordshire (UK)*** **Market:** rehabilitation of roadside embankment **Product:** compost **Overview:** this trial tested compost as an erosion control blanket when rehabilitating a roadside embankment. Two application techniques considered best Management practice by the US-EPA were tested.	**Soil challenges:** erosion **Treatment:** two compost 'mat' treatments were tested: (a) compost applied to the surface of the slope, and (b) compost applied to a mesh underlay (compost sock). Both techniques are considered best management practice by the US-EPA. **Result:** - Effective erosion control with both treatments (100% erosion control with the compost sock) - Increased soil moisture retention - Benefits observed for duration of trial 3 years (one application)
Roadside rehabilitation using compost[79] ***NSW*** **Market:** rehabilitation of roadside embankment **Product:** compost **Overview:** this trial tested compost as an erosion control blanket when rehabilitating a roadside embankment.	**Soil challenges:** erosion **Treatment:** apply as a compost 'mat' **Result:** - Effective erosion control **Learnings:** - Compost particle size influences effectiveness as an 'mat' - Aged compost improves the humus layer formed for more effective erosion control - Aged compost is better at collecting/binding impurities from contaminated surface water runoff from sealed roads

7.3.5 Remediation

Industrial remediation using compost[80] ***Whitehaven (UK)*** **Market:** rehabilitation of a former chemical processing facility **Product:** compost **Overview:** this trial tested compost as a soil medium, to facilitate remediation of an industrial site. The goal was to establish native vegetation and flowers (with shallow rooting depths) to improve the aesthetics of the site.	**Soil challenges:** no soil! the challenge is establishing plants on an industrial site without removing the underlying concrete slab **Treatment:** compost was applied in a layer (approximately 20cm thick) with rubble, directly on top of solid concrete **Result:** - The PAS 100 compost was more reliable than topsoil (as processing destroys weed seed burden) **Learnings:** - Traditional restoration using topsoil would have required 10,000 t/ha (costing £11.05 per m2), in comparison with 200 t/ha of compost (costing £2.49 per m2). With economies of scale costs could be reduced to £1.40 per m2 or less. - Compost on its own can be too rich for some plants (particularly given underlying concrete and limited access to soils), however, incorporating a % of compost can provide

[79] NSW EPA. 2018b. Case Study: Compost blanket project - Compost assists with roadside erosion control.
[80] WRAP. 2016. Landscape and Regeneration: Compost Case Studies

	the necessary nutrients and moisture retention for successful germination.

Appendix B

Review of Market Opportunity

Appendix B – Review of Market Opportunity

Market Development Strategy for FOGO-Derived Products

Waste Authority

16 June 2021

→ **The Power of Commitment**

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Printed date	16/06/2021 10:29:00 AM
Last saved date	16 June 2021
File name	https://projectsportal.ghd.com/sites/pp18_03/marketdevelopmentstr/ProjectDocs/12541803-0_Appendix B_Review of Market Opportunity.docx
Author	S Isbister, L Nordin, T Woods
Project manager	Natarsha Anne Woods
Client name	Waste Authority
Project name	Market Development Strategy for FOGO Derived Products
Document title	Appendix B – Review of Market Opportunity | Market Development Strategy for FOGO-Derived Products
Revision version	Rev 0
Project number	12541803

Document status

Status Code	Revision	Author	Reviewer		Approved for issue		
			Name	Signature	Name	Signature	Date
S3	A	S Isbister L Nordin T Woods	T Woods		M Gravett		31/05/2021
S4	0	S Isbister L Nordin T Woods	T Woods	pp	M Gravett		16/06/2021

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1. Objective

The Market Development Strategy for FOGO-Derived Products is focused on markets with the greatest potential for near-term acceptance of the volume of products expected to be generated from FOGO waste collected by Councils in the Perth and Peel region, to 2025. A Multi Criteria Analysis (MCA), Geographic Information System (GIS) mapping, GIS analysis and market size estimation processes were used to review market potential. Appendix B presents the methods and results for these processes.

2. Multi-Criteria Analysis (MCA)

2.1 Overview of method

An MCA process was used to rank markets to allow a focus on identifying and developing key strategies for growth and engagement in the highest ranked markets.

2.1.1 Criteria

The criteria used to assess each market are detailed in Table 1. Each criterion was given a weighting based on an assessment of the relative importance of each criterion. The final weighting represents a proportion of 100. The weighting system is presented in Table 2. Applying the weighting system to the criteria highlighted the most important criteria in selecting markets. The top ranked criteria were:

- Sensitivity to chemical contaminants
- Specifications, regulatory standards and policy barriers
- Proximity (i.e. location)
- Market size (quantity of use)

The weighting result matrix is presented in Table 3.

Table 1 Criteria for MCA

Criteria	Explanation	Weighting
Competitive advantage	How competitive is the FOGO product expected to be in comparison to its main competitor in this market?	9%
Proximity (i.e. location)	How far away is this end market from the processing site?	13%
Sensitivity to physical contaminants	How sensitive is this market to physical contaminants that are visible (e.g. glass, plastics)	7%
Sensitivity to chemical contaminants	How sensitive is this market to chemical contaminants (e.g. residual herbicide, PFAS, phthalates)	17%
Market size (quantity of use)	The potential quantity of FOGO-derived products that this market could absorb (annually) by 2030?	11%
Market demand (continuity and/or growth in demand)	Anticipated demand in this market for FOGO-derived products over a 10-year period?	10%
Market interest	How interested is this market expected to be in using FOGO-derived products (e.g., compost)?	6%
Market resistance	Is there expected to be general resistance in the market to FOGO-derived products regarding barriers that could be difficult to	6%

Criteria	Explanation	Weighting
	overcome (e.g., perceived risk of chemical contamination, glass, plastics etc)?	
Benefits to the market sector and WA	What are the socio-economic benefits from using FOGO-derived products in this market (e.g. improved soil health, erosion protection, reduced use of synthetic fertilizers, increased plant productivity / survival / resilience etc).	5%
Specifications, regulatory standards and policy barriers	Does this market require amendments to existing policy / standards / certification to support uptake?	16%
		100%

Table 2 Weighting system

Weighting System	
0	Much less important
1	Less important
2	Equally important
3	More important
4	Much more important

Table 3 Weighting result

Criteria	Competitive advantage	Proximity	Sensitivity to physical contaminants	Sensitivity to chemical contaminants	Market size	Market demand	Market interest	Market resistance	Benefits	Regulatory barriers	Count	Weight	Percentage	Rank
Competitive advantage		1	3	1	2	1	2	3	4	0	17	0.09	9%	6
Proximity	3		4	1	2	2	3	4	4	0	23	0.13	13%	3
Sensitivity to physical contaminants	1	0		1	3	1	2	2	3	0	13	0.07	7%	7
Sensitivity to chemical contaminants	3	3	3		4	4	4	4	4	2	31	0.17	17%	1
Market size	2	2	1	0		4	4	4	1	2	20	0.11	11%	4
Market demand	3	2	3	0	0		3	3	4	0	18	0.10	10%	5
Market interest	2	1	2	0	0	1		2	3	0	11	0.06	6%	8
Market resistance	1	0	2	0	0	1	2		4	0	10	0.10	6%	9
Benefits to the market sector and WA	0	0	1	0	3	0	1	0		4	9	0.05	5%	10
Regulatory barriers	4	4	4	2	2	4	4	4	0		28	0.16	16%	2

2.1.2 Market ranking

Information to complete the MCA was gathered from the stakeholder consultation processes, both the online survey and subsequent interviews. There were 55 surveys completed, however per industry the response rate was low, with some markets only having 1 or 2 responses. Markets that did not respond to the stakeholder consultation process have not been included, as it was considered that the interest from these markets is likely to be comparatively low so they would not be the initial focus of market development.

Compounding the low survey numbers, the information requested was often not known, creating considerable gaps. This is reflective of the developing nature of FOGO markets and their lack of awareness of FOGO-derived products. For these reasons, it is recommended that the MCA results should be tested with industry experts. However, the results are presented as a 'best available information' starting point for the Strategy.

Stakeholder consultation received responses from 8 different markets. Each market was assessed in the MCA, being assigned a Rank Score that was calculated by summing the weighting of points scored for each criterion.

Table 4 Market ranking Extensive Agriculture (cereal and stock)

Criteria for MCA	Weighting	1 Point	2 Points	3 Points	4 Points	5 Points	
Extensive Agriculture (cereal and stock)		Poor	Limited	Average	Very Good	Excellent	Score
Competitive advantage	9%	Not competitive, product will not sell	Slightly less competitive	Similar price and value	Slightly more competitive	Much more competitive	
How competitive is the FOGO product expected to be in comparison to its main competitor in this market?							0.19
Proximity (i.e. location)	13%	>200 km	150 - 200 km	100 - 150 km	50 - 100 km	<50 km	
How far away is this end market from the processing site?							0.51
Sensitivity to physical contaminants	7%	No tolerance	Very low tolerance	Low tolerance	Moderate tolerance	High tolerance	
How sensitive is this market to physical contaminants that are visible (e.g. glass, plastics)							0.14
Sensitivity to chemical contaminants	17%	No tolerance	Very low tolerance	Low tolerance	Moderate tolerance	High tolerance	
How sensitive is this market to chemical contaminants (e.g. residual herbicide, PFAS, phthalates)							0.17
Market size (quantity of use)	11%	Negligible	Low	Medium	High	Very High	
The potential quantity of FOGO-derived products that this market could absorb (annually) by 2030?							0.56
Market demand (continuity and/or growth in demand)	10%	Negligible	Low	Medium	High	Very High	
Anticipated demand in this market for FOGO-derived products over a 10 year period?							0.40
Market interest	6%	Not at all interested	Not very interested	Impartial	Interested	Very interested	
How interested is this market expected to be in using FOGO-derived products (e.g. compost)?							0.31
Market resistance	6%	Very High	High	Impartial	Low	Very Low	

Criteria for MCA	Weighting	1 Point	2 Points	3 Points	4 Points	5 Points	
Is there expected to be general resistance in the market to FOGO-derived products regarding barriers that could be difficult to overcome (e.g. perceived risk of chemical contamination, glass, plastics etc)?							0.11
Benefits to the market sector and WA	5%	Negligible	Low	Medium	High	Very High	
What are the socio-economic benefits from using FOGO-derived products in this market (e.g. improved soil health, erosion protection, reduced use of synthetic fertilizers, increased plant productivity / survival / resilience etc).							0.25
Specifications, regulatory standards and policy barriers	16%	New policy / standards / certification are required	Amendments to existing policy / standards / certification are required	Existing policy / standards / certification are borderline for this market	Existing policy / standards / certification are suitable for this market	Existing policy / standards / certification are well tailored to this market	
Does this market require amendments to existing policy / standards / certification to support uptake?							0.78
	100%					**Rank Score**	**3.42**

Table 5 Market ranking Mining Rehabilitation

Criteria for MCA	Weighting	1 Point	2 Points	3 Points	4 Points	5 Points	
Mining Rehabilitation		Poor	Limited	Average	Very Good	Excellent	Score
Competitive advantage	9%	Not competitive, product will not sell	Slightly less competitive	Similar price and value	Slightly more competitive	Much more competitive	
How competitive is the FOGO product expected to be in comparison to its main competitor in this market?							0.38
Proximity (i.e. location)	13%	>200 km	150 - 200 km	100 - 150 km	50 - 100 km	<50 km	
How far away is this end market from the processing site?							0.51
Sensitivity to physical contaminants	7%	No tolerance	Very low tolerance	Low tolerance	Moderate tolerance	High tolerance	
How sensitive is this market to physical contaminants that are visible (e.g. glass, plastics)							0.29
Sensitivity to chemical contaminants	17%	No tolerance	Very low tolerance	Low tolerance	Moderate tolerance	High tolerance	
How sensitive is this market to chemical contaminants (e.g. residual herbicide, PFAS, phthalates)							0.34
Market size (quantity of use)	11%	Negligible	Low	Medium	High	Very High	
The potential quantity of FOGO-derived products that this market could absorb (annually) by 2030?							0.33
Market demand (continuity and/or growth in demand)	10%	Negligible	Low	Medium	High	Very High	
Anticipated demand in this market for FOGO-derived products over a 10 year period?							0.40

Criteria for MCA	Weighting	1 Point	2 Points	3 Points	4 Points	5 Points	
Market interest	6%	Not at all interested	Not very interested	Impartial	Interested	Very interested	
How interested is this market expected to be in using FOGO-derived products (e.g. compost)?							0.31
Market resistance	6%	Very High	High	Impartial	Low	Very Low	
Is there expected to be general resistance in the market to FOGO-derived products regarding barriers that could be difficult to overcome (e.g. perceived risk of chemical contamination, glass, plastics etc)?							0.22
Benefits to the market sector and WA	5%	Negligible	Low	Medium	High	Very High	
What are the socio-economic benefits from using FOGO-derived products in this market (e.g. improved soil health, erosion protection, reduced use of synthetic fertilizers, increased plant productivity / survival / resilience etc).							0.25
Specifications, regulatory standards and policy barriers	16%	New policy / standards / certification are required	Amendments to existing policy / standards / certification are required	Existing policy / standards / certification are borderline for this market	Existing policy / standards / certification are suitable for this market	Existing policy / standards / certification are well tailored to this market	
Does this market require amendments to existing policy / standards / certification to support uptake?							0.31
	100%					**Rank Score**	**3.34**

Table 6 Market ranking Urban Amenity

Criteria for MCA	Weighting	1 Point	2 Points	3 Points	4 Points	5 Points	
Urban Amenity		Poor	Limited	Average	Very Good	Excellent	Score
Competitive advantage	9%	Not competitive, product will not sell	Slightly less competitive	Similar price and value	Slightly more competitive	Much more competitive	
How competitive is the FOGO product expected to be in comparison to its main competitor in this market?							0.38
Proximity (i.e. location)	13%	>200 km	150 - 200 km	100 - 150 km	50 - 100 km	<50 km	
How far away is this end market from the processing site?							0.51
Sensitivity to physical contaminants	7%	No tolerance	Very low tolerance	Low tolerance	Moderate tolerance	High tolerance	
How sensitive is this market to physical contaminants that are visible (e.g. glass, plastics)							0.14
Sensitivity to chemical contaminants	17%	No tolerance	Very low tolerance	Low tolerance	Moderate tolerance	High tolerance	
How sensitive is this market to chemical contaminants (e.g. residual herbicide, PFAS, phthalates)							0.34

Criteria for MCA	Weighting	1 Point	2 Points	3 Points	4 Points	5 Points	
Market size (quantity of use)	11%	Negligible	Low	Medium	High	Very High	
The potential quantity of FOGO-derived products that this market could absorb (annually) by 2030?							0.33
Market demand (continuity and/or growth in demand)	10%	Negligible	Low	Medium	High	Very High	
Anticipated demand in this market for FOGO-derived products over a 10 year period?							0.30
Market interest	6%	Not at all interested	Not very interested	Impartial	Interested	Very interested	
How interested is this market expected to be in using FOGO-derived products (e.g. compost)?							0.24
Market resistance	6%	Very High	High	Impartial	Low	Very Low	
Is there expected to be general resistance in the market to FOGO-derived products regarding barriers that could be difficult to overcome (e.g. perceived risk of chemical contamination, glass, plastics etc)?							0.22
Benefits to the market sector and WA	5%	Negligible	Low	Medium	High	Very High	
What are the socio-economic benefits from using FOGO-derived products in this market (e.g. improved soil health, erosion protection, reduced use of synthetic fertilizers, increased plant productivity / survival / resilience etc).							0.20
Specifications, regulatory standards and policy barriers	16%	New policy / standards / certification are required	Amendments to existing policy / standards / certification are required	Existing policy / standards / certification are borderline for this market	Existing policy / standards / certification are suitable for this market	Existing policy / standards / certification are well tailored to this market	
Does this market require amendments to existing policy / standards / certification to support uptake?							0.62
	100%					**Rank Score**	**3.30**

Table 7 Market ranking Extensive Agriculture (forestry)

Criteria for MCA	Weighting	1 Point	2 Points	3 Points	4 Points	5 Points	
Extensive Agriculture (Forestry)		Poor	Limited	Average	Very Good	Excellent	Score
Competitive advantage	9%	Not competitive, product will not sell	Slightly less competitive	Similar price and value	Slightly more competitive	Much more competitive	
How competitive is the FOGO product expected to be in comparison to its main competitor in this market?							.038
Proximity (i.e. location)	13%	>200 km	150 - 200 km	100 - 150 km	50 - 100 km	<50 km	
How far away is this end market from the processing site?							0.38
Sensitivity to physical contaminants	7%	No tolerance	Very low tolerance	Low tolerance	Moderate tolerance	High tolerance	

Criteria for MCA	Weighting	1 Point	2 Points	3 Points	4 Points	5 Points	
How sensitive is this market to physical contaminants that are visible (e.g. glass, plastics)							0.22
Sensitivity to chemical contaminants	17%	No tolerance	Very low tolerance	Low tolerance	Moderate tolerance	High tolerance	
How sensitive is this market to chemical contaminants (e.g. residual herbicide, PFAS, phthalates)							0.52
Market size (quantity of use)	11%	Negligible	Low	Medium	High	Very High	
The potential quantity of FOGO-derived products that this market could absorb (annually) by 2030?							0.11
Market demand (continuity and/or growth in demand)	10%	Negligible	Low	Medium	High	Very High	
Anticipated demand in this market for FOGO-derived products over a 10 year period?							0.30
Market interest	6%	Not at all interested	Not very interested	Impartial	Interested	Very interested	
How interested is this market expected to be in using FOGO-derived products (e.g. compost)?							0.24
Market resistance	6%	Very High	High	Impartial	Low	Very Low	
Is there expected to be general resistance in the market to FOGO-derived products regarding barriers that could be difficult to overcome (e.g. perceived risk of chemical contamination, glass, plastics etc)?							0.22
Benefits to the market sector and WA	5%	Negligible	Low	Medium	High	Very High	
What are the socio-economic benefits from using FOGO-derived products in this market (e.g. improved soil health, erosion protection, reduced use of synthetic fertilizers, increased plant productivity / survival / resilience etc).							0.10
Specifications, regulatory standards and policy barriers	16%	New policy / standards / certification are required	Amendments to existing policy / standards / certification are required	Existing policy / standards / certification are borderline for this market	Existing policy / standards / certification are suitable for this market	Existing policy / standards / certification are well tailored to this market	
Does this market require amendments to existing policy / standards / certification to support uptake?							0.78
	100%					**Rank Score**	**3.25**

Table 8 Market ranking Roads Development (major projects)

Criteria for MCA	Weighting	1 Point	2 Points	3 Points	4 Points	5 Points	
Roads Development (major projects)		Poor	Limited	Average	Very Good	Excellent	Score
Competitive advantage	9%	Not competitive, product will not sell	Slightly less competitive	Similar price and value	Slightly more competitive	Much more competitive	

Criteria for MCA	Weighting	1 Point	2 Points	3 Points	4 Points	5 Points	
How competitive is the FOGO product expected to be in comparison to its main competitor in this market?							0.28
Proximity (i.e. location)	13%	>200 km	150 - 200 km	100 - 150 km	50 - 100 km	<50 km	
How far away is this end market from the processing site?							0.38
Sensitivity to physical contaminants	7%	No tolerance	Very low tolerance	Low tolerance	Moderate tolerance	High tolerance	
How sensitive is this market to physical contaminants that are visible (e.g. glass, plastics)							0.29
Sensitivity to chemical contaminants	17%	No tolerance	Very low tolerance	Low tolerance	Moderate tolerance	High tolerance	
How sensitive is this market to chemical contaminants (e.g. residual herbicide, PFAS, phthalates)							0.69
Market size (quantity of use)	11%	Negligible	Low	Medium	High	Very High	
The potential quantity of FOGO-derived products that this market could absorb (annually) by 2030?							0.22
Market demand (continuity and/or growth in demand)	10%	Negligible	Low	Medium	High	Very High	
Anticipated demand in this market for FOGO-derived products over a 10 year period?							0.30
Market interest	6%	Not at all interested	Not very interested	Impartial	Interested	Very interested	
How interested is this market expected to be in using FOGO-derived products (e.g. compost)?							0.31
Market resistance	6%	Very High	High	Impartial	Low	Very Low	
Is there expected to be general resistance in the market to FOGO-derived products regarding barriers that could be difficult to overcome (e.g. perceived risk of chemical contamination, glass, plastics etc)?							0.22
Benefits to the market sector and WA	5%	Negligible	Low	Medium	High	Very High	
What are the socio-economic benefits from using FOGO-derived products in this market (e.g. improved soil health, erosion protection, reduced use of synthetic fertilizers, increased plant productivity / survival / resilience etc).							0.10
Specifications, regulatory standards and policy barriers	16%	New policy / standards / certification are required	Amendments to existing policy / standards / certification are required	Existing policy / standards / certification are borderline for this market	Existing policy / standards / certification are suitable for this market	Existing policy / standards / certification are well tailored to this market	
Does this market require amendments to existing policy / standards / certification to support uptake?							0.16
	100%					**Rank Score**	**2.95**

Table 9 Market ranking Local Government Parks and Gardens

Criteria for MCA	Weighting	1 Point	2 Points	3 Points	4 Points	5 Points	
Local Government Parks and Gardens		Poor	Limited	Average	Very Good	Excellent	Score
Competitive advantage	9%	Not competitive, product will not sell	Slightly less competitive	Similar price and value	Slightly more competitive	Much more competitive	
How competitive is the FOGO product expected to be in comparison to its main competitor in this market?							0.28
Proximity (i.e. location)	13%	>200 km	150 - 200 km	100 - 150 km	50 - 100 km	<50 km	
How far away is this end market from the processing site?							0.51
Sensitivity to physical contaminants	7%	No tolerance	Very low tolerance	Low tolerance	Moderate tolerance	High tolerance	
How sensitive is this market to physical contaminants that are visible (e.g. glass, plastics)							0.14
Sensitivity to chemical contaminants	17%	No tolerance	Very low tolerance	Low tolerance	Moderate tolerance	High tolerance	
How sensitive is this market to chemical contaminants (e.g. residual herbicide, PFAS, phthalates)							0.34
Market size (quantity of use)	11%	Negligible	Low	Medium	High	Very High	
The potential quantity of FOGO-derived products that this market could absorb (annually) by 2030?							0.33
Market demand (continuity and/or growth in demand)	10%	Negligible	Low	Medium	High	Very High	
Anticipated demand in this market for FOGO-derived products over a 10 year period?							0.30
Market interest	6%	Not at all interested	Not very interested	Impartial	Interested	Very interested	
How interested is this market expected to be in using FOGO-derived products (e.g. compost)?							0.31
Market resistance	6%	Very High	High	Impartial	Low	Very Low	
Is there expected to be general resistance in the market to FOGO-derived products regarding barriers that could be difficult to overcome (e.g. perceived risk of chemical contamination, glass, plastics etc)?							0.11
Benefits to the market sector and WA	5%	Negligible	Low	Medium	High	Very High	
What are the socio-economic benefits from using FOGO-derived products in this market (e.g., improved soil health, erosion protection, reduced use of synthetic fertilizers, increased plant productivity / survival / resilience etc.)?							0.25
Specifications, regulatory standards and policy barriers	16%	New policy / standards / certification are required	Amendments to existing policy / standards / certification are required	Existing policy / standards / certification are borderline for this market	Existing policy / standards / certification are suitable for this market	Existing policy / standards / certification are well tailored to this market	

Criteria for MCA	Weighting	1 Point	2 Points	3 Points	4 Points	5 Points	
Does this market require amendments to existing policy / standards / certification to support uptake?							0.31
	100%					**Rank Score**	**2.89**

Table 10 Market ranking Intensive Agriculture (orchards)

Criteria for MCA	Weighting	1 Point	2 Points	3 Points	4 Points	5 Points	
Intensive Agriculture (orchards)		Poor	Limited	Average	Very Good	Excellent	Score
Competitive advantage	9%	Not competitive, product will not sell	Slightly less competitive	Similar price and value	Slightly more competitive	Much more competitive	
How competitive is the FOGO product expected to be in comparison to its main competitor in this market?							0.38
Proximity (i.e. location)	13%	>200 km	150 - 200 km	100 - 150 km	50 - 100 km	<50 km	
How far away is this end market from the processing site?							0.38
Sensitivity to physical contaminants	7%	No tolerance	Very low tolerance	Low tolerance	Moderate tolerance	High tolerance	
How sensitive is this market to physical contaminants that are visible (e.g. glass, plastics)							0.22
Sensitivity to chemical contaminants	17%	No tolerance	Very low tolerance	Low tolerance	Moderate tolerance	High tolerance	
How sensitive is this market to chemical contaminants (e.g. residual herbicide, PFAS, phthalates)							0.34
Market size (quantity of use)	11%	Negligible	Low	Medium	High	Very High	
The potential quantity of FOGO-derived products that this market could absorb (annually) by 2030?							0.22
Market demand (continuity and/or growth in demand)	10%	Negligible	Low	Medium	High	Very High	
Anticipated demand in this market for FOGO-derived products over a 10 year period?							0.40
Market interest	6%	Not at all interested	Not very interested	Impartial	Interested	Very interested	
How interested is this market expected to be in using FOGO-derived products (e.g. compost)?							0.24
Market resistance	6%	Very High	High	Impartial	Low	Very Low	
Is there expected to be general resistance in the market to FOGO-derived products regarding barriers that could be difficult to overcome (e.g. perceived risk of chemical contamination, glass, plastics etc)?							0.17
Benefits to the market sector and WA	5%	Negligible	Low	Medium	High	Very High	
What are the socio-economic benefits from using FOGO-derived products in this market (e.g. improved soil health, erosion protection, reduced							0.15

Criteria for MCA	Weighting	1 Point	2 Points	3 Points	4 Points	5 Points	
use of synthetic fertilizers, increased plant productivity / survival / resilience etc).							
Specifications, regulatory standards and policy barriers	16%	New policy / standards / certification are required	Amendments to existing policy / standards / certification are required	Existing policy / standards / certification are borderline for this market	Existing policy / standards / certification are suitable for this market	Existing policy / standards / certification are well tailored to this market	
Does this market require amendments to existing policy / standards / certification to support uptake?							0.31
	100%					**Rank Score**	**2.82**

Table 11 Market ranking Intensive Agriculture (grazing)

Criteria for MCA	Weighting	1 Point	2 Points	3 Points	4 Points	5 Points	
Intensive Agriculture (grazing)		Poor	Limited	Average	Very Good	Excellent	Score
Competitive advantage	9%	Not competitive, product will not sell	Slightly less competitive	Similar price and value	Slightly more competitive	Much more competitive	
How competitive is the FOGO product expected to be in comparison to its main competitor in this market?							0.19
Proximity (i.e. location)	13%	>200 km	150 - 200 km	100 - 150 km	50 - 100 km	<50 km	
How far away is this end market from the processing site?							0.51
Sensitivity to physical contaminants	7%	No tolerance	Very low tolerance	Low tolerance	Moderate tolerance	High tolerance	
How sensitive is this market to physical contaminants that are visible (e.g. glass, plastics)							0.07
Sensitivity to chemical contaminants	17%	No tolerance	Very low tolerance	Low tolerance	Moderate tolerance	High tolerance	
How sensitive is this market to chemical contaminants (e.g. residual herbicide, PFAS, phthalates)							0.17
Market size (quantity of use)	11%	Negligible	Low	Medium	High	Very High	
The potential quantity of FOGO-derived products that this market could absorb (annually) by 2030?							0.33
Market demand (continuity and/or growth in demand)	10%	Negligible	Low	Medium	High	Very High	
Anticipated demand in this market for FOGO-derived products over a 10 year period?							0.20
Market interest	6%	Not at all interested	Not very interested	Impartial	Interested	Very interested	
How interested is this market expected to be in using FOGO-derived products (e.g. compost)?							0.18
Market resistance	6%	Very High	High	Impartial	Low	Very Low	
Is there expected to be general resistance in the market to FOGO-derived products regarding							0.11

Criteria for MCA	Weighting	1 Point	2 Points	3 Points	4 Points	5 Points	
barriers that could be difficult to overcome (e.g. perceived risk of chemical contamination, glass, plastics etc)?							
Benefits to the market sector and WA	5%	Negligible	Low	Medium	High	Very High	
What are the socio-economic benefits from using FOGO-derived products in this market (e.g. improved soil health, erosion protection, reduced use of synthetic fertilizers, increased plant productivity / survival / resilience etc).							0.10
Specifications, regulatory standards and policy barriers	16%	New policy / standards / certification are required	Amendments to existing policy / standards / certification are required	Existing policy / standards / certification are borderline for this market	Existing policy / standards / certification are suitable for this market	Existing policy / standards / certification are well tailored to this market	
Does this market require amendments to existing policy / standards / certification to support uptake?							0.31
	100%					**Rank Score**	**2.18**

2.2 Results of Market Ranking

The eight (8) Market Rank Scores were used to determine their Ranking for consideration for strategy focus.

Table 12 Ranked Markets

Rank	Market	Rank Score
1	Extensive agriculture (cereal and stock)	3.42
2	Mine rehabilitation	3.34
3	Urban amenity (residential)	3.30
4	Extensive agriculture (forestry)	3.25
5	Roads development (major projects)	2.95
6	Local Government parks and gardens	2.89
7	Intensive agriculture (orchards)	2.82
8	Intensive agriculture (grazing)	2.18

3. Market size

Estimates of Market Size were investigated to direct the strategy towards the high potential markets. Data obtained through survey, interview and GIS analysis did not provide concrete numbers for the calculation of market capacity. However, the consultation and market research has allowed initial numbers to be inferred. The calculation of market size should be refined as further information becomes available.

The following methodology from “Guide to Researching Agricultural Markets for Recycled Organics Products” (2007), was used to estimate the size of the top ranked markets where data was provided.

$$\text{Estimate Market Potential} = (A_v \times R/t)/M$$

$$\text{Where } A_v = A_t - A_n$$

Table 13 Estimate of Market Potential Calculation Parameters

Parameter		Data Source
A_v	Total number of hectares under cultivation viable for purchase/use of recycled organics	calculation
A_t	Total number of hectares under cultivation	GIS, market research
A_n	Total number of hectares not viable for recycled organics due to various factors	industry survey results
EAMP	Estimated market potential	calculation
R	Estimated application rate per hectare	ag trials, and industry survey results
t	Life of application in years	ag trials, and industry survey results
M	Market penetration target	industry survey results

3.1 Inputs to Market Potential Estimation Calculations

3.1.1.1 Extensive agriculture (cereal and livestock)

GIS analysis was used to determine the area of land used for cereal cropping and livestock within 100 km of FOGO processors. Survey results estimated that 90% of each property is arable and potentially suitable for FOGO-derived product application. Survey results estimated that a 5% market uptake was likely in the next 5 years. Data from completed agricultural trials was used to estimate the application rate of 10 tonnes per ha with an application frequency of 5 years.

3.1.1.2 Mine rehabilitation

There are a number of mineral and resource companies with mines located on the Swan Coastal Plain and Darling Scarp. In particular, those whose extraction method requires strip-mining (i.e. mineral sands) or removal of the overburden only (i.e. bauxite mining) generally have much larger disturbance footprints and a greater requirement to undertake progressive rehabilitation. Mine sites located in proximity to the Perth and Peel region are listed in Table 14. No information was presented in survey responses to allow the market to be quantified.

Table 14 Mineral and Resources Companies located in the proximity to the Perth and Peel Regions

Company	Mine locations	Rehabilitation frequency
Doral Mineral Sands	Yoongarillup Mine (Busselton) Keysbrook Mine (North Dandalup) Yalyalup Project (Busselton)	*Yoongarillup Mine is currently in decommissioning and rehabilitation phase.* *Keysbrook Mine operations are expected to cease in 2025.* *Yalyalup Project operations are expected to commence in 2023 and cease in 2027*
ILUKA	Eneabba	Progressive

Company	Mine locations	Rehabilitation frequency
	Cataby Capel	
Image Resources	Boonanarring Mine	Progressive
Alcoa	Willowdale Bauxite Mine Huntly Bauxite Mine	Progressive

3.1.1.3 Urban Amenity

Urban amenity is known to be the dominant market for recycled organic products across Australia, with the Australian Organics Recycling Association (AORA) estimating that urban amenity represents approximately 80% of the total market. Limited publicly available data is available to assess the impacts of progressive implementation of FOGO collection and processing in other jurisdictions. However, anecdotally it is understood that FOGO-derived products are generally not sold as “FOGO-derived” products and are often blended with other materials to manufacture blends for specific applications (e.g. landscaping soils).

3.1.1.4 Extensive agriculture (Forestry)

GIS analysis was used to determine how much forestry was within 100 km of processors. However, application of product in forestry is likely to be once only, at planting, in the 25-year growth cycle. As such data was sought from the Forest Product Commission website on recent planting rates. In 2019, 2775 ha of forestry was planted. This number was used to estimate annual market size. This data does not indicate distance from processors, so the actual accessible market size is probably much smaller.

Application rate was matched to cereal crops as no other data was available.

3.1.1.5 Road (Major Projects)

Quantifying potential use of FOGO-derived products in major development projects would require further consultation with Main Roads WA to understand their average annual use of imported organics (excluding mulch), and procurement specification requirements and project-specific constraints. Demand will ultimately be highly project-specific and therefore intermittent, however, there is interest from this market, and it is likely to have potential to use large volumes, relative to Local Government.

Major Road Development Projects are expected to be within proximity (50 – 150 km) of organics processors, however, due to the arterial nature of linear infrastructure projects, transport distance could increase to access all parts of a project. There may be a need for strategic stockpiling of committed product to service project-based demand to enable project schedule alignment. No information was presented to allow the market to be quantified.

3.1.1.6 Local Government – Parks and Gardens

Determining the potential uptake of FOGO-derived product within markets currently using organics and with good record keeping mechanisms, such as Local Government, is relatively reliable. Despite this, the volumes of organics used by individual Local Governments were also not widely shared through the survey, however, a Local Governments that did respond, the favored products were certified compost or soil conditioner (250 m^3 per annum), followed by certified landscaping soil (50 m^3 per annum) and certified potting mix (10 m^3 per annum). These numbers were used as a proxy to predict potential consumption of FOGO-derived products if all Local Governments within the Perth and Peel region were to ‘buy back’ the products.

Local Governments of the Perth and Peel region are in close proximity (0 – 100 km) to organics processors. Transport of product to this end-market is expected to be the most feasible. Survey results predicted market uptake of 30% in the first five years.

3.1.1.7 Intensive Agriculture (Orchards)

GIS analysis was used to determine the area of orchards within 100 km of FOGO processors. Data from National Maps for areas of irrigated citrus, irrigated fruit trees, irrigated olives, irrigated tree nuts and olives was used.

Survey results estimated that 100% of each property is arable and suitable for FOGO product application. Survey results estimated that a 5% market uptake was likely in the next 5 years.

Application rate and frequency was matched to cereal crops as no other data was available.

3.1.1.8 Intensive Agriculture (Grazing)

GIS analysis was used to determine the area of irrigated grazing such, as dairying (from National Maps) within 100 km of FOGO processors. Survey results estimated that 50% of each property is arable and suitable for FOGO product application. Survey results estimated that a 30% market uptake was likely in the next 5 years.

Application rate and frequency was matched to cereal crops as no other data was available.

3.2 Results

The results of calculations are shown in Table 15. There is a low level of certainty in the actual numbers, however the relative market size is useful. Extensive agriculture (cereal and stock) has the largest estimated market potential. It has the ability to use 100% of the FOGO component of FOGO-derived products predicted to be available by 2025 (145,000 tonnes[1]). The next biggest market is intensive agriculture (grazing). No data was available to estimate the size of the urban amenity, mine rehabilitation nor road development markets.

Table 15 Estimate of market size calculation

	Input data						
	A_v	A_t	A_n	R	T	M	Estimate of Market Potential
Markets							**tonnes**
Extensive Agriculture (cereal and stock)	1,970,254	2,189,171	218,917	10	5	5%	197,025
Mine Rehabilitation	-	-	-	-	-	-	-
Urban Amenity (residential)	-	-	-	-	-	-	-
Extensive Agriculture (forestry)	2,220	2,775	555	10	1	10%	2,220
Roads development (major projects)	-	-	-	-	-	-	-
Local Government parks and rec	12,090	12,090	0	1	1	30%	3,627
Intensive Agriculture (Orchards)	11,556	11,556	0	10	5	5%	1,156
Intensive Agriculture (Grazing)	723,496	723,496	361,748	10	5	5%	36,175

[1] Waste Authority. 2021. WA FOGO Reference Group (www.wasteauthority.wa.gov.au)

4. Mapping

4.1 Overview of method

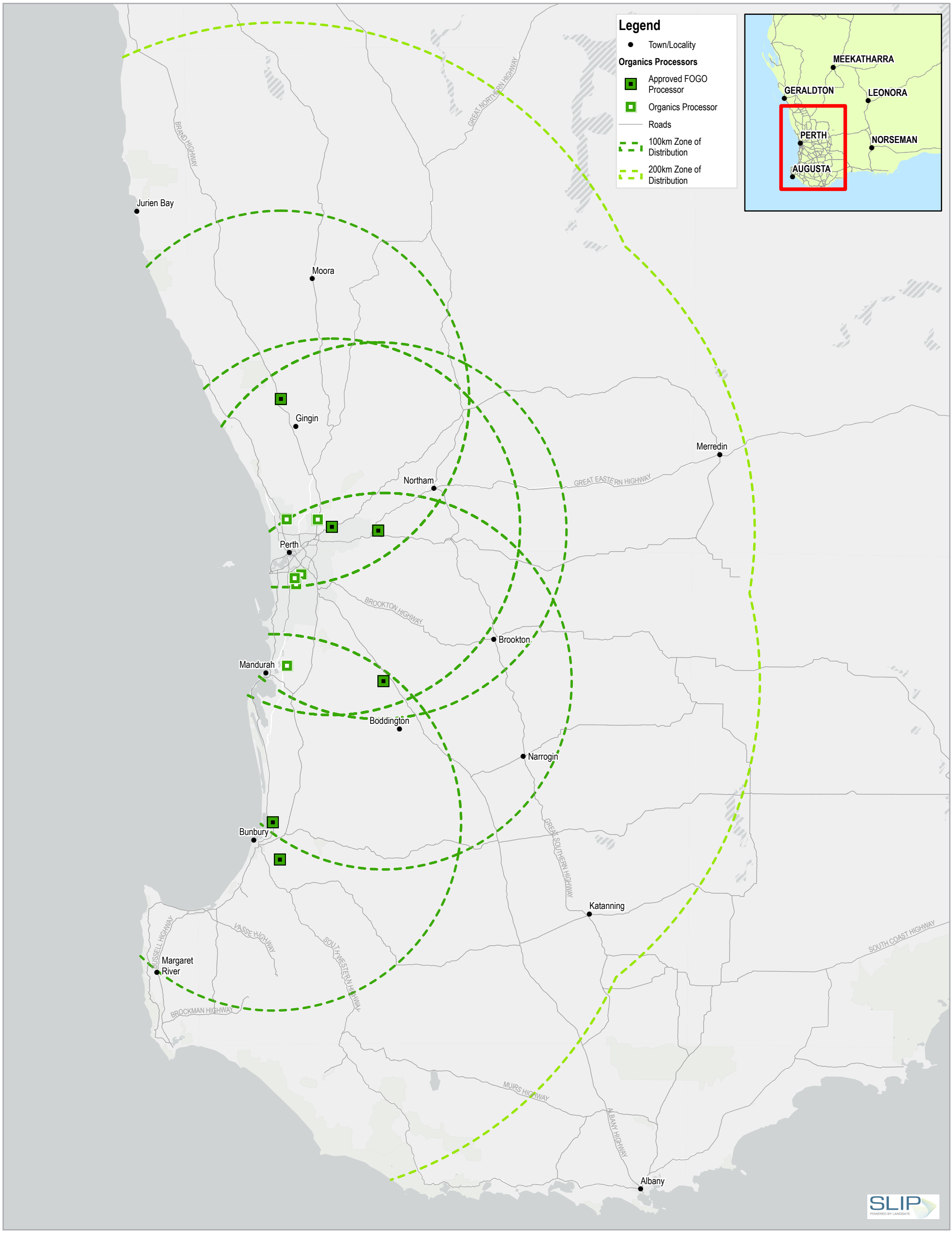
The basis of each of the six maps)used to understand market potential is detailed in Table 16. The MCA process determined Mining Rehabilitation to be the second ranked market, however the limited data available has meant that an estimate of Market Potential has not been completed. Noting the distribution of mining activities in the area of reach (economic transport distance) of FOGO processing facilities, Map 4 demonstrates that this market that market development in this area is warranted.

Table 16 Mapping method and data sets

Figure No.	Figure name	Map shows	Datasets	Calculations
Map 1	Product distribution potential	– Processors – Primary roads – Major Cities / Towns – Zones of distribution (100 km, 200 km, 300 km buffers)	Processor table for facility location points and approval status	n/a
Map 2	Market location – extensive agriculture	**Map 1 plus:** – Cropping – Grazing – Forestry	**Broad-acre agricultural land** NationalMap dataset "Catchment Scale Land Use 2018 [Agricultural industries]" has attributes for 'grazing modified pastures and 'cropping' **Forestry** NationalMap dataset "Hardwood NFI Plantations 2016" and "NFI Softwood Plantations 2016"	Area of "grazing" intersecting 100 km processor buffer Area of "cropping" intersecting 100 km processor buffer Area of "hardwood" intersecting 100 km processor buffer Area of "softwood" intersecting 100 km processor buffer
Map 3	Market location - intensive agriculture	**Map 1 plus:** – Orchards – Market Gardens – Vineyards	**Orchards / Market Gardens** NationalMap "Catchment Scale Land Use 2018 [Agricultural industries]" has an attribute for horticulture **Vineyards** NationalMap "Grape Marc" (in bioenergy) has an attribute for vineyards	Area of "horticulture" intersecting 100 km processor buffer Number of "vineyards" intersecting 100 km processor buffer
Map 4	Market location - mine rehabilitation	**Map 1 plus:** – Mines (see list)	Refer to list of relevant mines for site location points	Number of "mine sites" intersecting 100 km processor buffer [visual check okay]
Map 5	Market location – local governments	**Map 1 plus:** – Perth and Peel Local Governments (see list) – Wellington Regional Group of Councils (City of Bunbury, Shire of Harvey, Shire of Capel, Shire of Dardanup, Shire of Collie, Shire of Donnybrook-Balingup and the Shire of Boyup Brook).	Refer to list of relevant Local Governments	n/a
Map 6	Market location – development projects (road/rail/property)	**Map 1 plus:** – Add rail	What would be ideal is a layer that shows areas targeted for future urban development (housing / road / rail) – chat to some of the WA GIS people and see what you can dig up. Alternatively, we can highlight existing areas of urban development.	n/a

Figure No.	Figure name	Map shows	Datasets	Calculations
			The only layer I have found that might be marginally useful is NationalMap dataset “Catchment Scale Land Use 2018 [Primary classification]” and attribute for intensive uses	

5. Market distribution maps



Paper Size ISO A3

0 10 20 30 40

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

GHD

Department of Water and Environmental Regulation
Market Development Strategy
for FOGO Derived Products

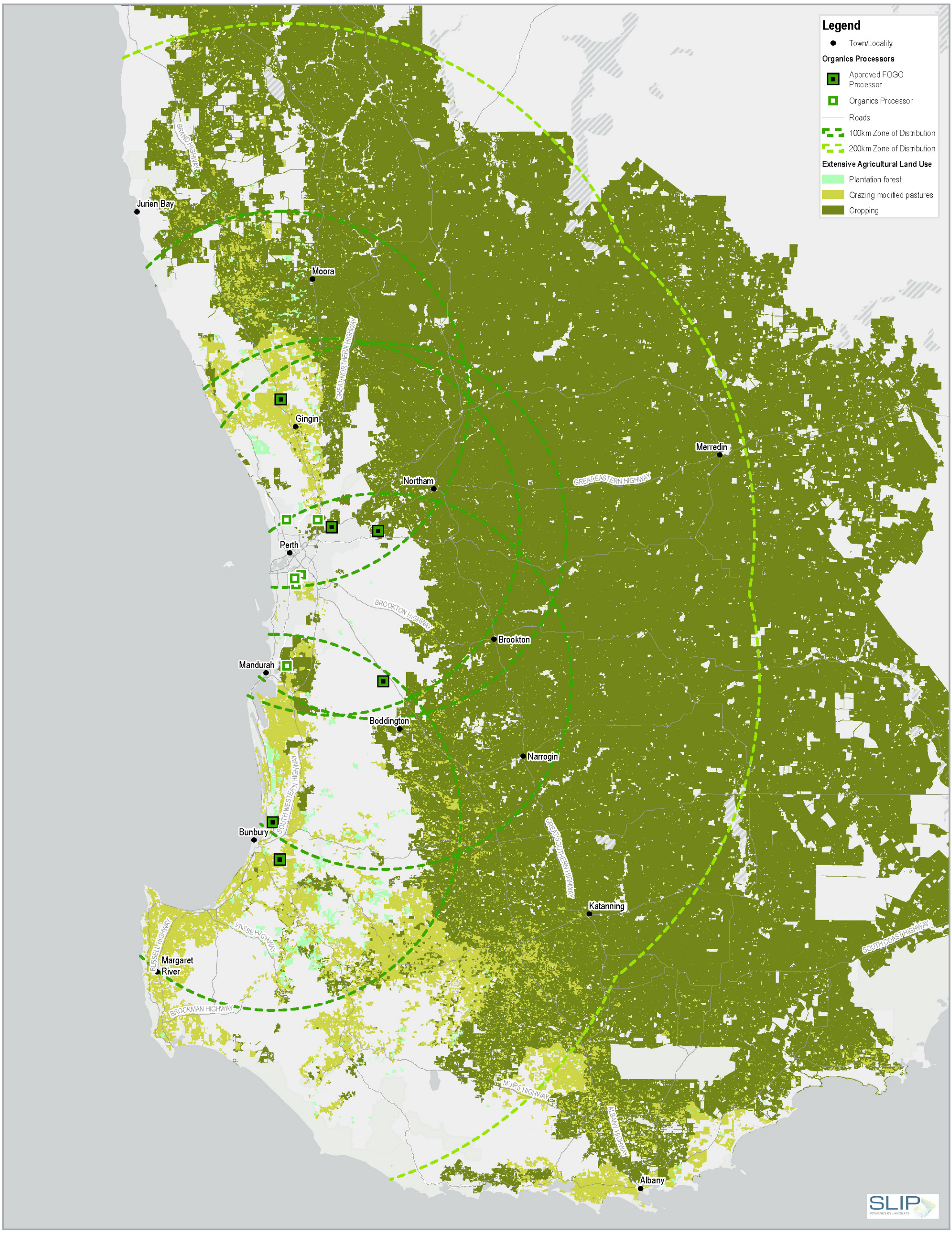
Project No. **2541803**
Revision No. **0**
Date **15/06/2021**

Product Distribution Potential

FIGURE 1

N:\AU\Perth\Projects\61\12541803\GIS\Maps\Working\12541803_FOGO_MarketDevelopmentStrategy\12541803_FOGO_MarketDevelopmentStrategy.aprx\12541803_001_HeatMap1_RevA
Print date: 24 May 2021 - 16:06

Data source: Light Gray Base: Esri, HERE, Garmin, FAO, NOAA, USGS GA: Roads, Town/Locality. GHD: Processors - 20210520, Zone of Distribution - 20210521. Created by: tngavranic



Paper Size ISO A3

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Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

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Department of Water and Environmental Regulation
Market Development Strategy
for FOGO Derived Products

Market Location
Extensive Agriculture

Project No. **12541803**
Revision No. **0**
Date **16/06/2021**

FIGURE 2

N:\AU\Perth\Projects\61\12541803\GIS\Maps\Working\12541803_FOGO_MarketDevelopmentStrategy\12541803_FOGO_MarketDevelopmentStrategy.aprx\12541803_002_HeatMap2_RevA
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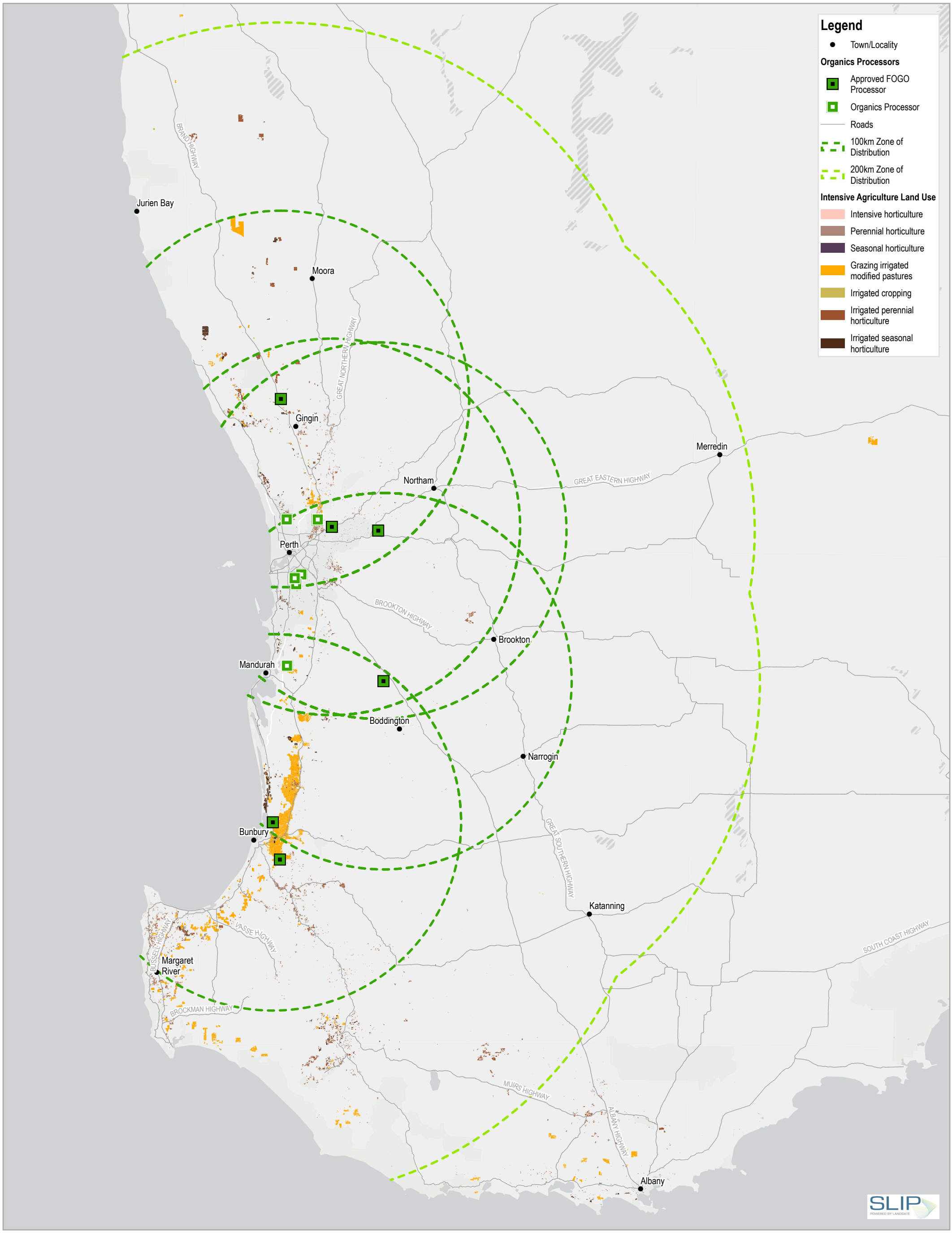
Created by: tngavranic



Paper Size ISO A3

0 10 20 30 40

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

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Department of Water and Environmental Regulation
Market Development Strategy
for FOGO Derived Products

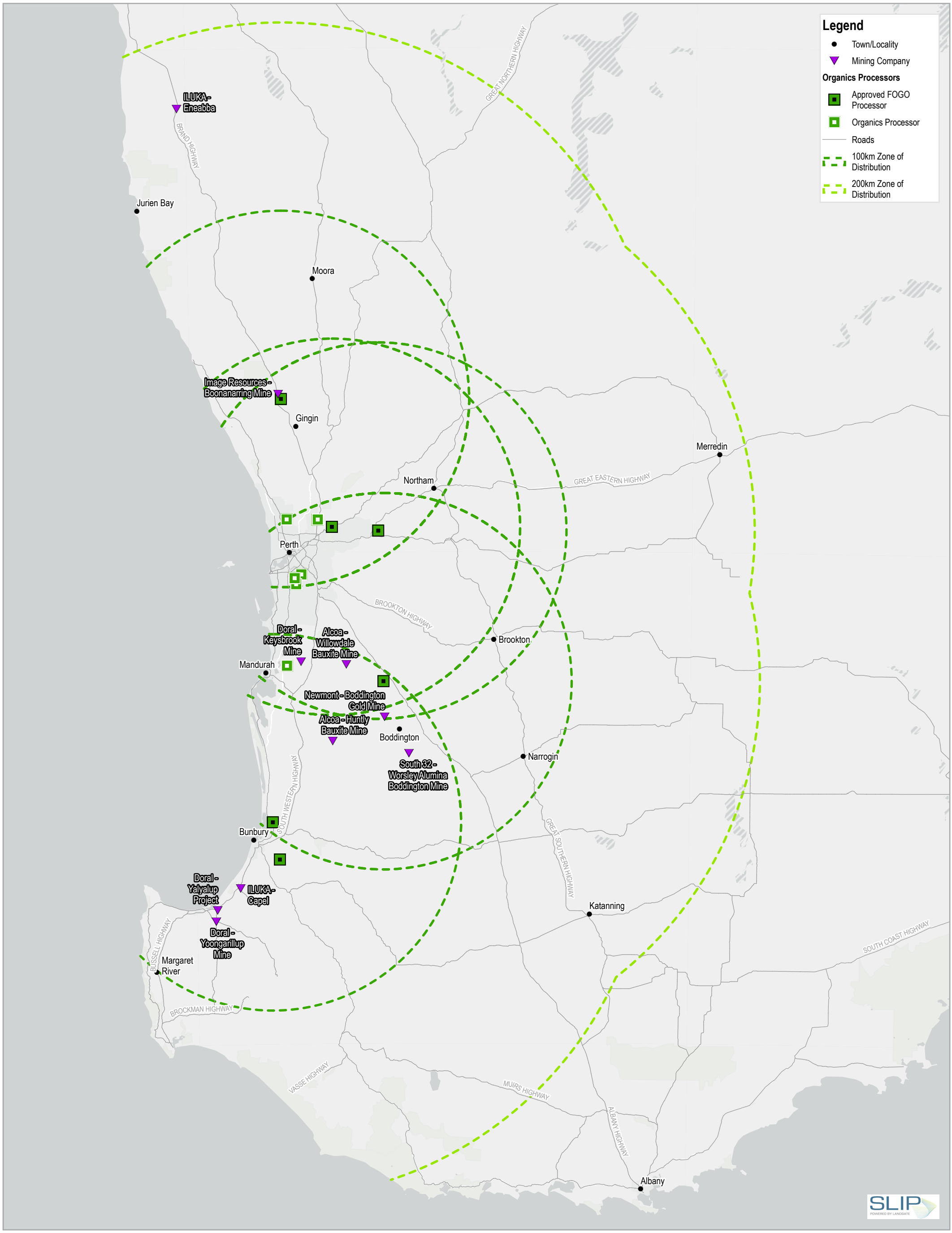
Market Location
Intensive Agriculture

Project No. **12541803**
Revision No. **0**
Date **16/06/2021**

FIGURE 3

N:\AU\Perth\Projects\61\12541803\GIS\Maps\Working\12541803_FOGO_MarketDevelopmentStrategy\12541803_FOGO_MarketDevelopmentStrategy.aprx\12541803_003_HeatMap3_RevA
Print date: 24 May 2021 - 16:07

Data source: Light Gray Base: Esri, HERE, Garmin, FAO, NOAA, USGS GA: Roads, Town/Locality. ABARES: Agricultural Industries - 2018. GHD: Processors - 20210520, Zone of Distribution - 20210521. Created by: tngavranic



Paper Size ISO A3

0 10 20 30 40

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

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Department of Water and Environmental Regulation
Market Development Strategy
for FOGO Derived Products

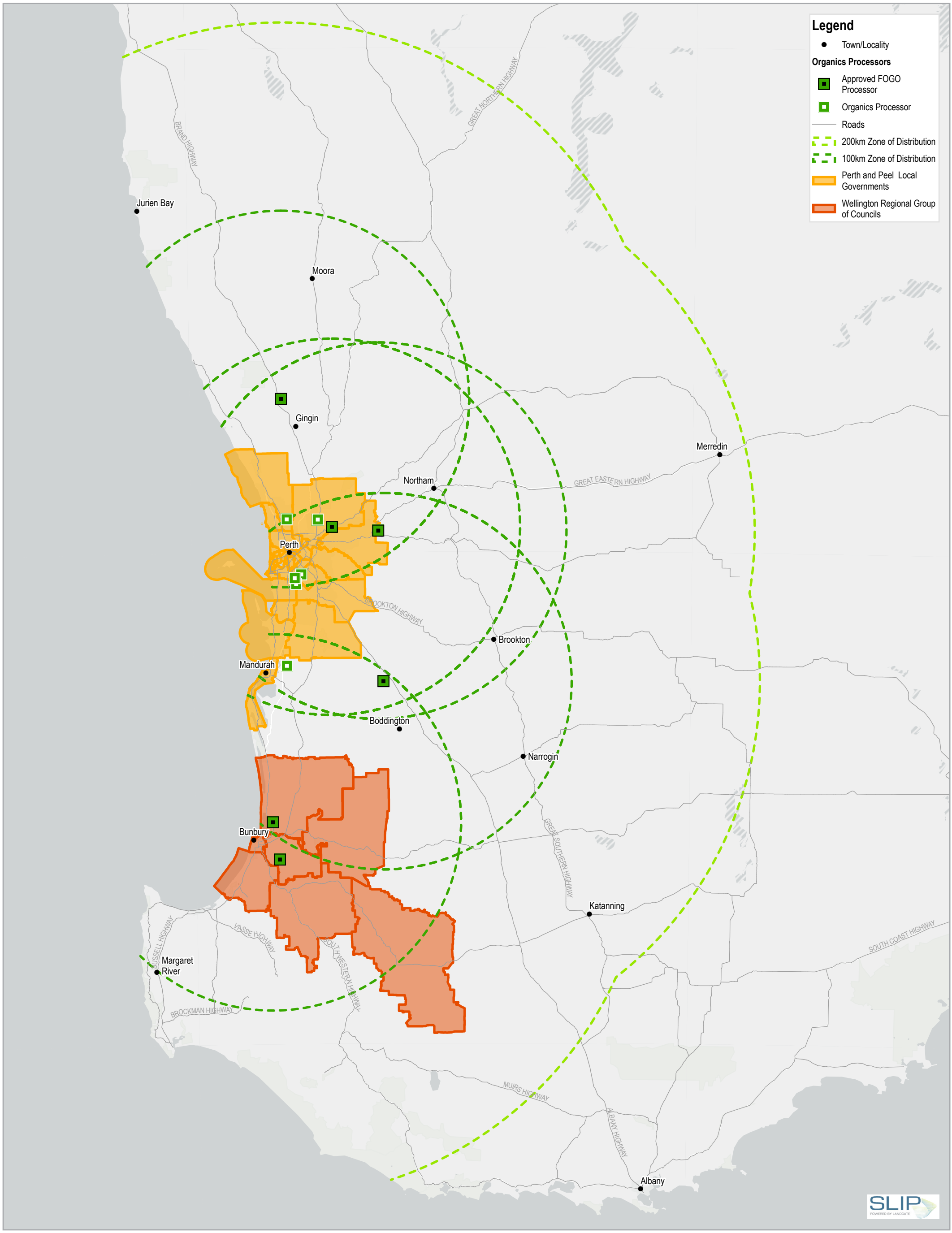
Market Location
Mine Rehabilitation

Project No. **12541803**
Revision No. **0**
Date **15/06/2021**

FIGURE 4

N:\AU\Perth\Projects\61\12541803\GIS\Maps\Working\12541803_FOGO_MarketDevelopmentStrategy\12541803_FOGO_MarketDevelopmentStrategy.aprx\12541803_004_HeatMap4_RevA
Print date: 24 May 2021 - 16:07

Data source: Light Gray Base: Esri, HERE, Garmin, FAO, NOAA, USGS GA: Roads, Town/Locality. ABARES: Agricultural Industries - 2018. GHD: Processors and Mines - 20210520, Zone of Distribution - 20210521. Created by: tngavranic



Paper Size ISO A3

0 10 20 30 40

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

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Market Development Strategy
for FOGO Derived Products

Market Location
Local Government

Project No. **12541803**
Revision No. **0**
Date **16/06/2021**

FIGURE 5

N:\AU\Perth\Projects\61\12541803\GIS\Maps\Working\12541803_FOGO_MarketDevelopmentStrategy\12541803_FOGO_MarketDevelopmentStrategy.aprx\12541803_005_HeatMap5_RevA
Print date: 24 May 2021 - 16:07

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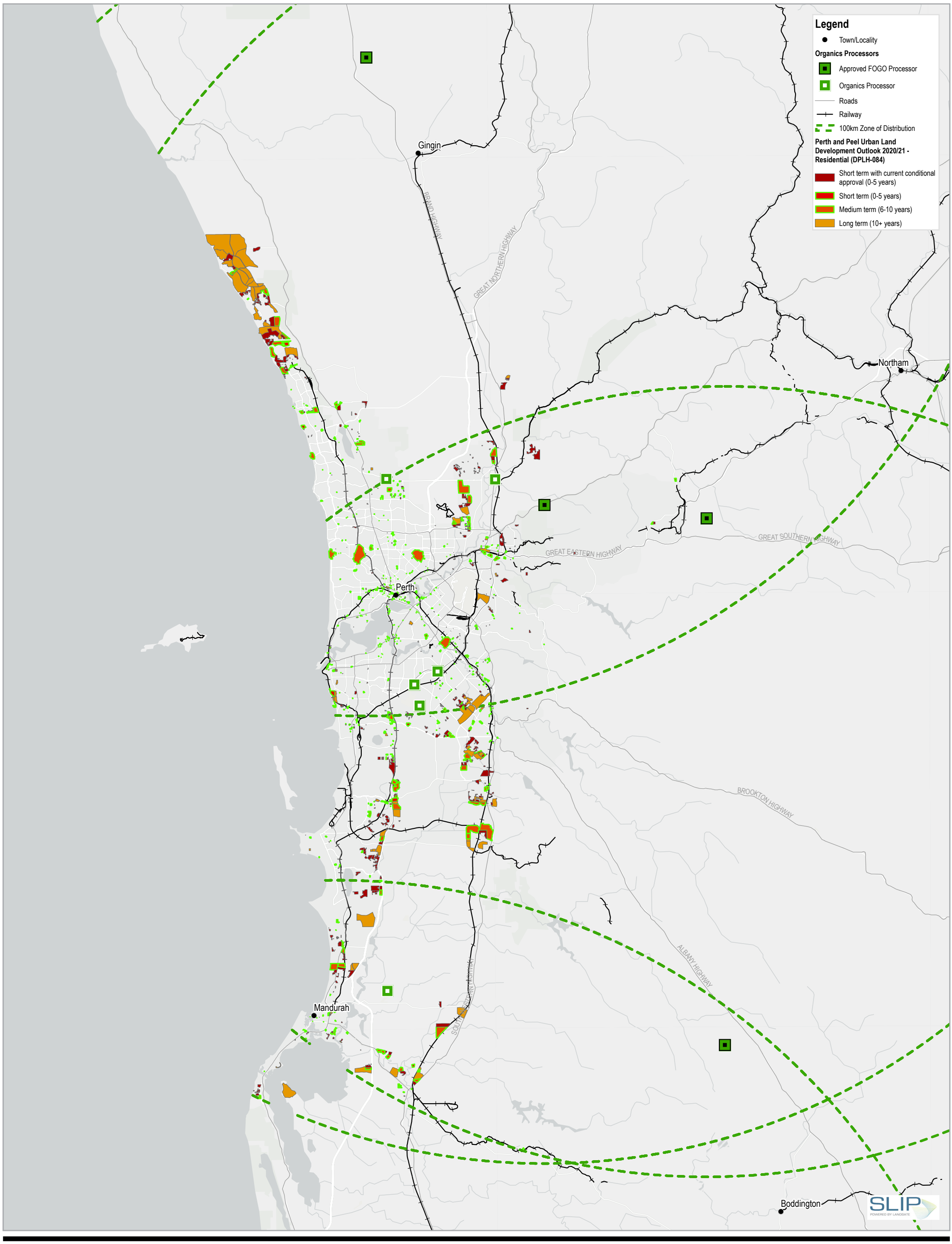

Paper Size ISO A3

0 5 10 15 20

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

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Department of Water and Environmental Regulation
Market Development Strategy
for FOGO Derived Products

Market Location
Development Projects

Project No. **12541803**
Revision No. **0**
Date **16/06/2021**

FIGURE 6

N:\AU\Perth\Projects\61\12541803\GIS\Maps\Working\12541803_FOGO_MarketDevelopmentStrategy\12541803_FOGO_MarketDevelopmentStrategy.aprx\12541803_006_HeatMap6_RevA
Print date: 26 May 2021 - 07:16

Data source: Light Gray Base: Esri, HERE, Garmin, FAO, METI/NASA, USGS GA: Roads, Town/Locality. Landgate: Road and Rail - 20210524. DPLH: Perth and Peal Urban Land Development Outlook - 2020/21 - Residential (DPLH-084) - 20210525. GHD: Processors - 20210520, Zone of Distribution - 20210521. Created by: tngavranic

Appendix C

Actions

Appendix C – Actions

Market Development Strategy for FOGO-Derived Products

Waste Authority

16 June 2021

→ **The Power of Commitment**

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Printed date	16/06/2021 10:01:00 AM
Last saved date	16 June 2021
File name	https://projectsportal.ghd.com/sites/pp18_03/marketdevelopmentstr/ProjectDocs/12541803-0_Appendix E_Actions.docx
Author	Sarah Isbister
Project manager	Natarsha Anne Woods
Client name	Waste Authority
Project name	Market Development Strategy for FOGO Derived Products
Document title	Appendix C – Actions | Market Development Strategy for FOGO-Derived Products
Revision version	Rev 0
Project number	12541803

Document status

Status Code	Revision	Author	Reviewer		Approved for issue		
			Name	Signature	Name	Signature	Date
S3	Rev A	S. Isbister L. Nordin	M. Gravett		M. Gravett		1/06/2021
S4	Rev A	S. Isbister L. Nordin	M. Gravett		M. Gravett		16/06/2021

1. Actions

A list of key prospective actions (Table 1) has been developed for consideration by the Waste Authority. The list is intended to inform subsequent development of an Action Plan to support development of new markets for recycled organics products, while fostering growth in existing markets, with particular focus on FOGO-derived products.

The suggested actions seek to address key barriers identified across the organic waste recovery, recycling and reuse supply chain. The potential actions outlined are informed by learnings from national and international experience, and input from key stakeholders (government, industry and markets) gathered through the online survey platform and follow-up interviews in developing the Market Development Strategy for FOGO-Derived Products.

Table 1 Prospective actions to support market development for FOGO-derived products

	Action	Desired outcome
	REGULATION / POLICY / CONTRACTS	
1	Increase the landfill levy to further disincentivise disposal of recyclable organic material (e.g. FOGO) to landfill *Note: a review of the WA Waste Avoidance and Resource Recovery (WARR) levy framework in WA has been in development and it is expected that a schedule of planned increases will be published on completion of the levy review.*	Divert more organic waste from landfill Alter Local Government perception around 'cost of processing' and 'value for money' if there is an equal or greater cost to dispose to landfill Alter Local Government perception of FOGO as a 'waste' to FOGO as a 'valuable resource' and opportunity to reduce cost
2	Local Government to include a "buy back" clause in waste recovery contracts with FOGO processors, possibly incentivised by discount on purchase of FOGO-derived products, closing the loop commercially	Drive improvements in feedstock quality through alignment of commercial objectives and shared responsibility for contamination management Underwriting annual sales for a proportion of the total FOGO derived products produced
3	State Government to mandate targets for State Government Departments to procure minimum recycled content that is compliant with relevant Australian Standards and specifications for FOGO-derived products.	Growth in market demand for FOGO-derived products Targets should align with relevant objectives and principles in the WA Sustainable Procurement Guideline[1] and WA Supply Commission Sustainable Procurement Policy[2] (Department of Finance, 2020).
4	State Government to mandate targets for Local Government to procure minimum recycled content that is compliant with relevant Australian Standards and specifications for FOGO-derived products.	Growth in market demand for FOGO-derived products via implementation of sustainable procurement guidelines across all local governments in Perth and Peel. Making this reportable drives action by Local Governments to procure recycled content Targets should align with relevant objectives and principles in the WA Sustainable Procurement Guideline and WA Supply Commission Sustainable Procurement Policy (Department of Finance, 2020).
5	Introduce mandatory requirement for Local Governments to audit FOGO collected from households in their Council area	Auditing process will drive improved contamination management by Local Councils Greater risk and responsibility sharing with processors Annual auditing and reporting by all Councils in Perth and Peel collecting FOGO waste, for comparison with best practice performance. Auditing supports achievement of targets; for example, achieving less than 3% contamination (by weight), with a future target of less than 1% contamination; significant ongoing progress towards 'target zero' Informed community education and messaging.
6	Introduce mandatory requirement for Local Governments to report contamination statistics in FOGO collected from households in their Council area, and their	Reporting contamination statistics will provide Local Councils with benchmarking against peers, so that improvements can be measured

[1] https://www.wa.gov.au/government/publications/sustainable-procurement-guideline
[2] Government of Western Australia: Department of Finance. 2021. Revoked: State supply commission sustainable procurement policy (www.wa.gov.au).

	Action	Desired outcome
	progress towards 'target zero'. Introduce deadline for reporting and penalties for non-compliance. Publish data on *My*Council website[3] (Department of Local Government, Sport and Cultural Industries)	Publishing results will ensure data transparency, allowing individual Councils to see what is possible and learn from those Councils with leading performance. This will drive implementation of better practice measures for reducing contamination in FOGO collected for processing. Trend monitoring feeds into ongoing community education and messaging FOGO has less than 3% contamination (by mass) in Councils that have been collecting FOGO for less than 2 years. FOGO has less than 1% contamination in Councils that have been collecting FOGO for more than 2 years. Long term, strive towards significantly less than 1%, targeting zero contamination.
7	Develop a statewide and/or regional approach to manage stockpiling of recycled organics products. For example, establishing a regional facility or strategically located stockpiles of quality managed market-ready product, to address seasonality and discontinuous but defined market demand and meet supply commitments with schedule alignment.	Have available sufficient volumes of market-ready product to service known market or project-based demand and supply commitments Avoid stockpiling recycled organics products in urban or semi-urban areas
8	Where large volumes of stockpiled recycled organics products need to be moved quickly, explore temporary subsidies towards the purchase price or transport costs for the extensive agricultural market	Avoid stockpiling recycled organics products in semi-urban areas Incentivise uptake of FOGO-derived products into the extensive agricultural market, increasing future demand
9	Gate fee charged (for processing) should reflect physical contamination level. Provision in contracts to allow processors to charge a higher gate fee to Local Governments where contamination exceeds agreed levels.	Incentivise Councils to take action to reduce FOGO feedstock contamination, improving the quality of end-products
10	Explore options for charge residents directly for repeat incidents of bin contamination, as part of local law, or consider temporary withdrawal of FOGO service (reverting to two bins); provide opt-in arrangements for reinstatement of FOGO service	Householders incentivised to use their three bins appropriately, to reduce FOGO contamination, improving quality of end-products Reduced FOGO feedstock contamination by exclusion of highly contaminated sources of FOGO waste
11	Investigate the need for mandatory independent auditing of quality management programs at FOGO processing facilities	Regular auditing of batch test results and quality management protocols help build market trust around FOGO-derived products
12	Explore regulatory mechanisms for reducing use of chemical contaminants in commercial and residential garden maintenance Interventions may include banning retail sale of persistent pesticides and herbicides or limiting herbicide use, or directing residents to discard 'treated' vegetation via red-lid bin instead of FOGO bin	Reduce the risk of persistent chemicals contaminating FOGO feedstock and FOGO-derived products.
	STANDARDS / CERTIFICATION / GUIDELINES	
12	Finalise and implement DWER Guideline: Better Practice Composting	Greater investment certainty for industry and confidence in processing throughout supply chain, including Councils, processors and end users.

[3] Department of Local Government, Sport and Cultural Industries. 2021. Compare all councils (www.wa.gov.au).

	Action	Desired outcome
13	Collaborate with industry, state government and federal government to develop a new standard for FOGO-derived products. The quality assurance framework must be built on the requirements from each end market, to develop industry specific 'fit-for-purpose' product specifications. The resulting standard must meet market expectations for quality and risk (contamination) tolerance. This may include stricter testing and lower contamination tolerance.	Build market trust and demand through developing a standard specifically for FOGO-derived products, with specifications for target markets which meet product quality and contamination expectations A consistent high quality product will also increase market willingness to pay a higher price
14	Engage with peak bodies, (e.g. AORA, WALGA), to tighten existing guidance and standards to improve QA/QC of FOGO-derived products, tied back to managing contamination levels in FOGO collected.	Tightening of existing standards will improve product quality in the near term, improving marketability, until such time as a new standard for FOGO-derived products is developed. Improving product quality and consistency is the first step required to develop new and existing markets for FOGO-derived products, particularly those which are most sensitive to contaminants.
15	Assess the need for the industry to introduce a new type of certification standard, which is applied to the whole supply chain (from feedstock to process to end product).	A more holistic approach to managing contamination. Supply-chain certifications are common internationally and have been shown to produce higher quality end products. Review international lessons learnt (Appendix A).
16	Develop FOGO guidelines for: - Local Councils on how to introduce collection services for FOGO material that encourages low contamination levels - Processors to support implementation of a quality management approach that produces higher quality products - Better practice methods and guidance for applying FOGO-derived products to land (application rates, frequency, soil testing etc)	FOGO-specific guidelines have been a useful tool in Victoria for supporting development of end-markets
17	Develop regulation/certification framework for digestate from anaerobic digestion (AD) (solid and liquid) products.	Clarity around whether liquid digestate must be pasteurised and solid digestate must be composted before use. Development of standards specifically for AD co-products builds market trust and provides investment certainty for industry
	PRODUCT AND MARKET DEVELOPMENT	
18	Provide targeted funding support for development of value-added products, in consultation with target markets	Increased market confidence, encouraging processors to invest in product development, and if required, new technologies Products meet market expectations and drive productivity Markets can differentiate quality-managed FOGO-derived compost from other recycled organics materials
19	State Government to consider making funding available to assist processors in transition to FOGO to: - Explore feasibility of investing in advanced technologies to produce a pelletised (or liquid) product	Easier application - a pelletised or liquid product can be applied during seeding reducing effort and cost (particularly important in a broad-acre agricultural setting)

	Action	Desired outcome
		Organics incorporated into the soil profile deliver longer lasting soil health benefits Reduce cost burden on processors for processing FOGO-derived products Build market confidence in product quality Applicants should demonstrate how funding will assist them in achieving Strategy targets and vision
20	Undertake consultation with the most promising markets to identify internal processes / protocols which may need to undergo review prior to purchasing FOGO-derived products.	Understand internal processes/protocols of State Government Departments Identify documents or contracts which may require amending/updating to facilitate use of FOGO-derived products (e.g. landscaping specifications, contractor requirements). Encourage State Government Departments to update these.
21	Introduce short-term subsidies/discounts to target markets to incentivise uptake of FOGO derived products	Subsidies and discounts encourage use of FOGO-derived products (over organics products currently used), enabling markets an opportunity to test the quality and benefits derived from product use. Assuming FOGO-derived products are of a consistently high quality with low levels of contamination, this process will establish market trust and drive future demand for FOGO-derived products
22	Explore strategies for achieving a competitive advantage against competing products, or comfortably co-existing with these products. Market the competitive advantage of FOGO-derived products, where differentiation is demonstrated/possible	Strategies should aid in developing FOGO-derived products which are high quality, low contamination, considered affordable, and adding value to the end market.
23	Investigate options for identifying and/or adapting a compost benefit calculator to assist with product marketing	A soil nutrition improvement calculator is appropriately benchmarked and demonstrating the value and benefits of FOGO derived products to end users
	COLLABORATION	
24	Consider development of a best practice commercial model whereby Local Governments and processors share in both downside/risk and upside reward.	Full cost of processing included in gate fees, with profits on sale of products shared back to Local Government via rebates or discounts on purchase of FOGO-derived products and/or reduced gate fees Councils incentivised to reduce feedstock contamination levels Reduced net processing costs (benefits shared by Local Government and processor)
25	Effective FOGO pre-sort and screening by Regional Local Governments before transport to processing (where processing is outsourced)	Manage and reduce feedstock contamination Reduced processing costs Better quality products achieving market acceptance
26	Processors to share knowledge and agree protocols and processes for managing FOGO feedstock contamination, which may include: - Appropriate pre-sort technology/processes - Refining of final product/s	Reduced contamination in FOGO-derived products Building market trust and demand with consistent high-quality product

	Action	Desired outcome
27	Encourage householders to use FOGO-derived products, educating them on where their FOGO goes and how it is processed, closing the loop on municipal organics	Householders can readily access FOGO-derived products that are clearly labelled with their FOGO content, enabling them to recognise value in organic waste and their contribution to reducing feedstock contamination Reduced feedstock contamination Reduced decontamination and processing costs, with savings shared by Councils and processors Higher quality end-products
28	Establish regional facilities for temporary storage of FOGO-derived products to increase transport efficiencies and reduce transport cost for buyers where purchase commitments exist. This approach would have the added benefit of reducing stockpiling of organic materials in semi-urban areas which has the potential to cause odour issues.	Reduce net transport costs Reduced stockpiling of organics in urban and semi-urban areas Satisfy project-based and campaign-based supply commitments where product delivery and application activities are time constrained and/or seasonal (e.g. infrastructure projects and extensive agriculture)
29	Provide facilitation and procurement process alignment to enable processors to work collaboratively to produce required volumes of FOGO-derived products to service larger orders (e.g. for major projects and rehabilitation activities)	Economies of scale reduce costs and produce significant quantities of 'made to order' niche or specific products that meet market demand
	EDUCATION AND INFORMATION SHARING	
30	Develop a state-wide approach to education around FOGO	Reduce additional cost burden on Local Governments and organics processors introducing FOGO collection/processing services Messaging should be simple, consistent and catchy, building on successes elsewhere Education should: - Target grassroots change (i.e. provide education through schools) - Target the entire organics supply chain (residents, drivers, pickers, processors, end markets). - Showcase success stories - Showcase benefits of FOGO-derived products and returning recycled organics to soil - Seek to educate residents on correct source separation to reduce feedstock contamination, including addressing common misconceptions (i.e. the difference between compostable and biodegradable bags). Mindset shift towards viewing education as an investment (not a cost)
31	Provide funding support to Local Governments to develop education material for their residents	Develop localised marketing material Run TV / radio / social media campaigns Use educational material developed by states with the most experience in FOGO recycling (NSW, SA, Victoria)

	Action	Desired outcome
32	Leverage existing industry groups and events (e.g. Natural Resource Management groups and agricultural field days) to reach end users. Use these groups and events to share knowledge around product attributes and trial results (e.g. benefits, application rates, costs, availability etc). Promote successful case studies.	NRM groups working as a strong extension mechanism and actively sharing information, identifying early adopters and supporting end users (existing and potential) Build market interest in and awareness of FOGO-derived products Change market perception from 'waste-derived product' to 'quality beneficial product' Increase market understanding of product benefits and differentiation from other organics products (where appropriate)
33	Promote FOGO-derived products via marketing campaigns, and educate the industry and selected end markets on benefits of using FOGO derived products	Informed end users in selected markets actively seeking, sourcing and using high quality FOGO-derived and other recycled organic products
34	Develop a platform/forum/webinar series for Regional Local Government / Local Government / Processors to share learnings	Foster better/best practice management Reduce feedstock contamination Produce high quality end products Provide opportunity for collaborative information exchange and knowledge transfer
	FUNDING	
36	State/National Government to make funding available to undertake research to identify chemical contaminants (in FOGO wastes collected) that are of greatest concern to target markets, potential sources and suitable mitigations, based on learnings internationally and in other Australian jurisdictions.	Clear understanding of the extent, prevalence and range of concentrations of contaminants of concern found in FOGO-derived products in Western Australia. Sensitive markets have confidence that contamination risks are appropriately mitigated and managed
37	State Government to consider making funding available to assist processors in transition to FOGO to: - Invest in innovative processing technologies - Remove contaminants from FOGO feedstock (i.e. through investment in high efficiency decontamination equipment) - Increase testing of products to meet stricter standards - Explore the feasibility of investing in advanced technologies to produce a pelletised (or liquid) product.	Reduce cost burden on processors for processing FOGO-derived products Build market confidence in product quality Applicants should demonstrate how funding will assist them in achieving Strategy targets and vision
38	State Government to make available funding for trials to demonstrate cost (and other) benefits in target markets to use in education campaigns	Overcome market perceptions (particularly those held by Local Government) that FOGO-derived products are contaminated and the product quality inconsistent Uptake of new products and technologies is progressive, farmers trust other farmers and are more likely to consider new practices if benefits are demonstrated locally. Trials will support this process. Focus on key markets: Extensive Agriculture (forestry, cereal, stock) and Mine Rehabilitation.

	Action	Desired outcome
		Characterise performance of FOGO-derived products to enable reliable competition with fertilizers and other established soil amendments. Trials should consider exploring the role FOGO-derived compost can play in disease suppression/resistance
39	State Government to make funding available for a State-wide community education campaign around FOGO implementation	Reduce additional cost burden on Local Governments and organics processors introducing FOGO collection/processing services Ongoing and effective community education is effectively reducing feedstock contamination
40	State/National Government to make funding available to sample and test FOGO-derived products for persistent pesticides and herbicides and other contaminants of concern	Informed risk assessment identifies mitigations that can be implemented for ongoing chemical contamination characterisation/monitoring and management Acceptable contaminant levels in FOGO-derived products in WA
41	Consider providing funding to State Government Departments and Local Governments to identify where FOGO-derived products can be included in future procurement of recycled organic soil amendments (recommended by SMRC and Main Roads WA)	Market pull developed around government procurement, to supplement demand growth in other areas
	COLLECTION SERVICES	
42	Develop policies and guidance around how to best manage FOGO feedstock contamination	Develop best practice guidelines that support introduction of education, contamination monitoring and other interventions to successfully control and reduce contamination Local Governments to implement interventions for managing feedstock contamination, which may include: - Monitoring contamination with cameras (e.g. in the hopper of the collection truck) - Issuing warnings to residents for incorrect bin use (e.g. warning stickers) - Face-to-face consultation with residents (where contamination issues are identified) to offer support and guidance on correct bin use - Consultation with drivers to identify offending/problem areas - Detailed composition audits on all three bins. Monitor sources of feedstock contamination. In areas where contamination is unacceptably high, first issue warnings/advice notes and undertake consultation. If bin contamination continues, withdraw the FOGO bin and revert to 240 liter red lid bin; allow opt-in for return to FOGO service if/when requested

	Action	Desired outcome
43	Investigate the role of compostable packaging in FOGO, its impact on product quality and implications for processors	Guidance provided around compostable packaging used – aligned with Australian Standards for home composting AS 5810-2010 and or industrial composting AS 4736-2006 and clearly labelled (WMR 2018[4]).

[4] WMR. 2018. 'Raising the bar for composting in Australia' In Waste Management Review, 27 Nov, 2018. Available online: https://wastemanagementreview.com.au/raising-bar-composting-australia/

Appendix D

References

Appendix D - References

Market Development Strategy for FOGO-Derived Products

Waste Authority

16 June 2021

→ **The Power of Commitment**

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Printed date	16/06/2021 10:16:00 AM
Last saved date	16 June 2021
File name	https://projectsportal.ghd.com/sites/pp18_03/marketdevelopmentstr/ProjectDocs/12541803-0_Appendix D_References.docx
Author	S Isbister, J Jamphel
Project manager	Natarsha Anne Woods
Client name	Waste Authority
Project name	Market Development Strategy for FOGO-Derived Products
Document title	Appendix D - References | References
Revision version	Rev 0
Project number	12541803

Document status

Status Code	Revision	Author	Reviewer		Approved for issue		
			Name	Signature	Name	Signature	Date
S3	A	S Isbister J Jamphel	S Isbister		M Gravett		4/06/2021
S4	0	S Isbister J Jamphel	S Isbister	pp	M Gravett		16/06/2021

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