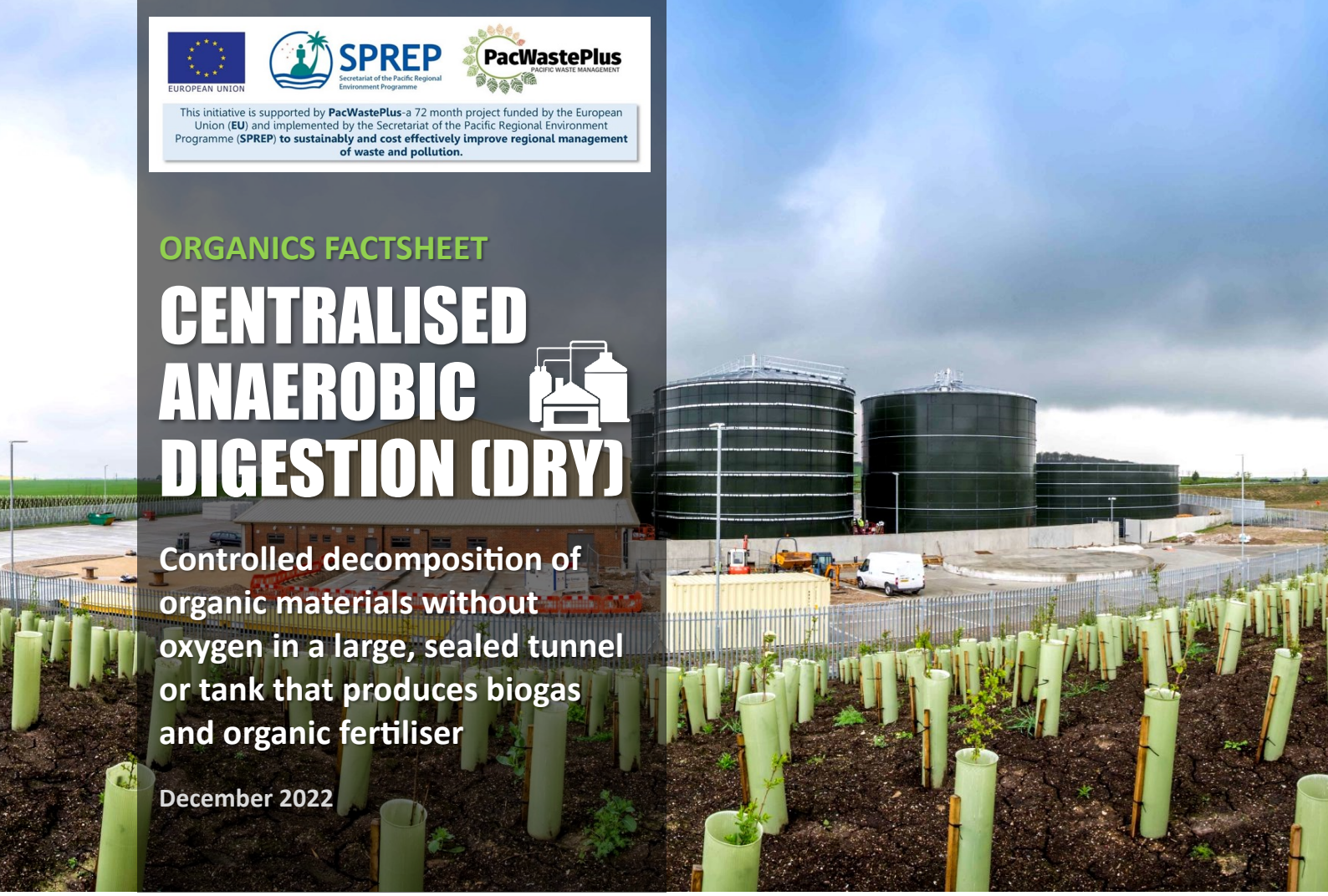
This initiative is supported by **PacWastePlus**-a 72 month project funded by the European Union (**EU**) and implemented by the Secretariat of the Pacific Regional Environment Programme (**SPREP**) **to sustainably and cost effectively improve regional management of waste and pollution.**

ORGANICS FACTSHEET

CENTRALISED ANAEROBIC DIGESTION (DRY)

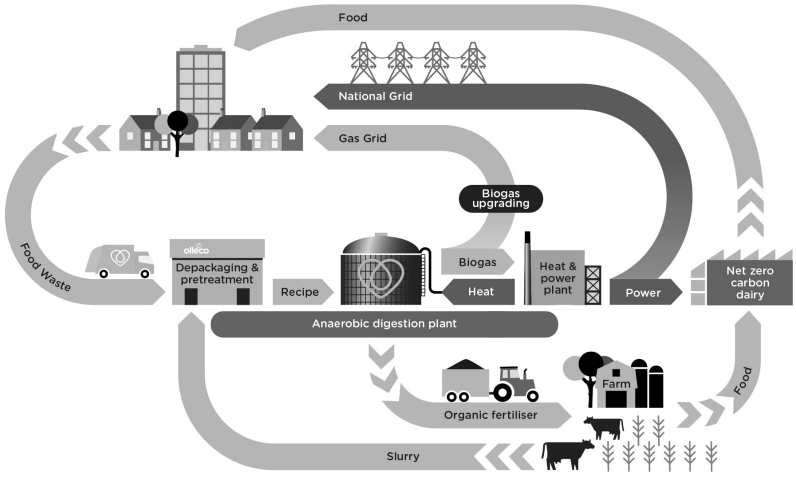


Controlled decomposition of organic materials without oxygen in a large, sealed tunnel or tank that produces biogas and organic fertiliser

December 2022

Biogas is a green energy and has the potential to reduce greenhouse gas emission. Due to climate change and increasing fuel prices, large-scale biogas production may provide an effective opportunity to consider.

Large-scale anaerobic digestion can convert organic material such as sludge from wastewater treatment plants or slurries from the agriculture (*manure*) industry into two usable resources:



Biogas, can be either used to power the facility (*heating reactors*), upgraded to a transport fuel (*natural gas*), combusted in a power plant, or fed into the grid

Digestate, a solid material that is dry (*sometimes pelletised*) and used as a compost or organic fertiliser.

Large-scale anaerobic digestion may be suitable for digesting (*breaking down*) large quantities of organic materials (*more than 20 tonne or 400 wheelbarrows/day*) for towns and cities. Digestors are supplied, constructed, and commissioned by specialist contractors. Organic material is loaded and unloaded mechanically.

There are many different designs and types are available - most of them are high-tech and require expert construction, operation, and maintenance servicing.

This factsheet is for decision-makers and entrepreneurs considering the management of organics through the establishment of a **large-scale anaerobic digestion system** and provides information on recommended conditions, design features, equipment, and an overview of typical operations.

This publication provides information to enable an informed decision on whether this solution is appropriate.



A large-scale anaerobic digestion system is an organics management solution most suited to a situation where:

- Large quantities of organic material (*more than 20 tonne or 400 wheelbarrows/day*) are available, is currently being disposed, burnt, or otherwise discarded, and can be brought to one location for resource recovery
- There is donor aid or investment capital available of at least USD$200,000 to invest into a large-scale anaerobic digester
- A site of approximately 15,000m^2 is available and located at least 250m from sensitive neighbours (i.e., communities and schools)
- Consistent input materials of sufficient volume are identified for a period of at least 10 years to justify the investment, and there is a willingness/agreement for the waste generators to pay for the service offered by the digester
- There is a use for the electricity and organic fertiliser near where the plant is located, ideally on the same island
- A government or other established organisation can complete required high-level planning to confirm facility suitability, activities to undertake during the planning phase include:
  - characterised organic inputs and confirm that the anaerobic digestion technology can process them effectively
  - complete a business case, including a financial and/or cost-benefit analysis of the proposed project
  - obtain necessary approvals for construction and operation of a large facility
- Tertiary educated staff will be available to supervise ongoing operations

Note: commonly scale anaerobic digestion facilities are co-located with a wastewater treatment plants or large generators of commercial organic wastes, and/or with an industrial scale activity that can use the electricity heat generated

Large-Scale Anerobic Digestion System Overview

Organic Material Inputs

Collection and Processing Requirements

All types of organic materials:

- Food organics
- Biosolid / Human sludge
- Animal manure
- Soft garden organics, including noxious weeds
- Paper and cardboard

- Organic materials added into the digester; materials can be added as they are generated - no need for storage or sorting
- Digester processes material and output products held until ready to be used
- Excess biogas is either burnt off or automatically released to the air via a valve to avoid exceeding the maximum storage pressure of the system.

Product Outputs

- Biogas, used:
  - powering the facility
  - upgraded to a transport fuel
  - combusted in a power plant
  - fed into the grid

- Digestate, used as a compost or organic fertiliser

Typical Buyers / Users

- Gardens, fruit and vegetable production, cropping, for general improvement of soil health and quality, and plant nutrient supply
- Biogas used for heating the reactors, upgraded to a transport fuel (*natural gas*), combusted in a combined heat and power plant, or fed into the grid

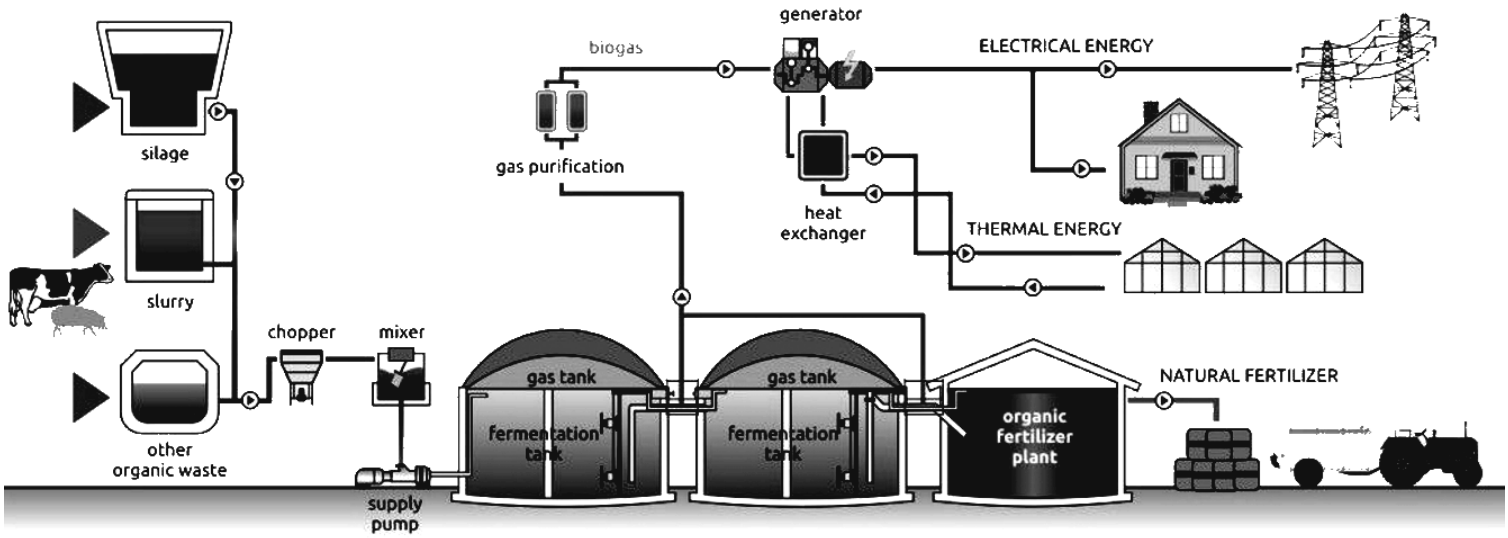
Process Overview

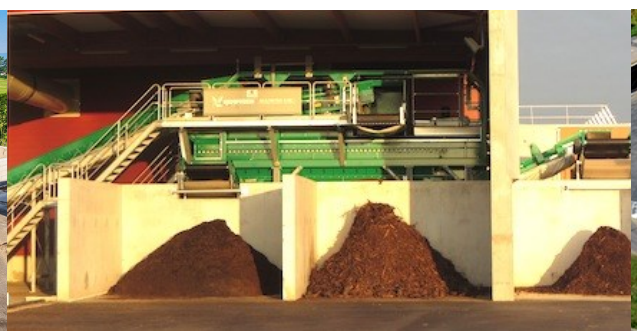
Suitable Organic Material Inputs	• Food organics (fruit and vegetable) • Biosolid / Human sludge • Animal manure • Soft garden organics, including noxious weeds • Paper and cardboard • Fat, oil, and grease collected from the food service industry	
Unsuitable Organic Material Inputs	• Fibrous or woody garden organics, • Plastics and other household waste	
Product Output	• Biogas, can be either used to power the facility (*heating reactors*), upgraded to a transport fuel (*natural gas*), combusted in a combined heat and power plant, or fed into the grid • Digestate, a solid material that is dry (*sometimes pelletised)* and used as a compost or organic fertiliser	
Speed	• Approximate time periods range from 5-90 days, more commonly 10-30 days, depending on the makeup of the feedstock and type of anaerobic digester	
Difficulty	• Very difficult, tertiary educated staff required to supervise ongoing operations • Constructed anaerobic digestors typical provided with training for facility operation.	
Typical Collection Sites	• Wastewater treatment plants • Large generators of commercial organic wastes, such as large growers' markets, intensive animal husbandry facilities	
Processing throughput	• Limited by available staff and equipment, typically >10,000kg/day to justify capital investment. • Preferred scale = 50,000kg/day	
Typical output production	• The energy potential is significant. As just one example, 50,000kg/day, anaerobic digestion can generate enough energy to power 400 - 700 homes each year. • The volume of digestate able to be used as compost will be around 90-95% of what was fed into the digester.	
Space requirement for processing for processing preferred scale	• Each square metre of a large-scale anaerobic digestion can process 3-6m^3 / year (*1-3 tonnes*) of organic materials. This means processing 50 tonne/day (*50,000kg/day*) of organic material will require about 15,000m^2 for the facility footprint. • The footprint depends on factors such as: – The expected amount (*volume or weight*) of organic materials – Whether the digestate is further composted, dried or pelletised on-site – The size and type of plant and equipment used • Facilities include space for: – Raw material blending, storage, and processing (*shredding*) – Storage and refining of digestate – Traffic access and vehicle parking – Offices and amenities	
Capital Cost $US	• US$>500,000	
Typical operating costs US$/tonne	• US$100-150/tonne at preferred scale	
Key Equipment / Requirements	**Recommended Elements**	
	Digester Design Features	• Large-scale anaerobic digestion systems are generally supplied, constructed, and commissioned by specialist contractors as ready to operate engineering projects • Recommended to select a supplier that has a successful track record of delivering anaerobic digestion projects in other locations. Before engaging, it may be beneficial to visit existing facilities that have been operating for 3 years or more to assess their performance and suitability • During the procurement phase engage a local engineer to assist and oversee facility design and construction • Mechanical ventilation system and biofilter - air is removed from the building at least 2 times per hour and treated with a biofilter (*filter to remove odours)* • Large-scale anaerobic digestion facilities located in an enclosed building on sealed paving • Gas storage facility and flare • Heat and power plant • Water recirculation system including tank(s), pipes, and pumps
	Other equipment	• Bucket loader, such as a front-end loader or telehandler • Shredder or chipper
	Equipment for composting	• Recommended equipment to enhance use of digestate as compost: • Screen • Drying and pelletising plant • Bagging machine and bags
	Signage	• Effective signage at digester to illustrate the process and requirements
	Education materials	• Education materials (*flyers, posters*) to educate industry and businesses using the digester on how to separate and process organics for use digester
	Staff	• Tertiary educated staff required to supervise ongoing operation
	Procedures and training	• Standard Operating Procedure for staff to comply with • Training required for operating equipment, collecting material, running site, delivering awareness messages

SWOT Analysis – Large-Scale Anaerobic Digestion

Strengths	Weaknesses
• Produces significant quantities of biogas that could replace some diesel use on islands • Produces an organic liquid fertiliser with relatively high levels of available nutrients (*compared to compost*) • Excellent control of process and impacts on local environment • Well understood, proven technologies, with extensive training & technical support available • Effective way of managing biosolids (*sewage sludge*)	• High initial capital cost for civil work, structures and equipment • More complex to operate than in-vessel composting systems • Requires high levels of education and training to operate • Relies on imported equipment from range of suppliers
Opportunities	**Threats**
• Consider for largest urban centres (*capitals*) • Receive and process biosolids and other highly putrescible organics (*that are not recommended for other organic management systems*)	• Insufficient organic materials generated on even the largest urban centres insufficient for facility operation at a cost effective scale • Poor operation results in high GHG emissions (*methane*)

Illustrative Diagram of a Large Scale Anaerobic Digestion System





PacWastePlus Programme

The Pacific – European Union (EU) Waste Management Programme, PacWastePlus, is a 72-month programme funded by the EU and implemented by the Secretariat of the Pacific Regional Environment Programme (SPREP) to improve regional management of waste and pollution sustainably and cost-effectively.

About PacWastePlus

The impact of waste and pollution is taking its toll on the health of communities, degrading natural ecosystems, threatening food security, impeding resilience to climate change, and adversely impacting social and economic development of countries in the region. The PacWastePlus programme will generate improved economic, social, health, and environmental benefits by enhancing existing activities and building capacity and sustainability into waste management practices for all participating countries. Countries participating in the PacWastePlus programme are: *Cook Islands, Democratic Republic of Timor-Leste, Federated States of Micronesia, Fiji, Kiribati, Nauru, Niue, Palau, Papua New Guinea, Republic of Marshall Islands, Samoa, Solomon Islands, Tonga, Tuvalu, Vanuatu*.

KEY OBJECTIVES

Outcomes & Key Result Areas

The overall objective of PacWastePlus is "to generate improved economic, social, health and environmental benefits arising from stronger regional economic integration and the sustainable management of natural resources and the environment".

The specific objective is "to ensure the safe and sustainable management of waste with due regard for the conservation of biodiversity, health and wellbeing of Pacific Island communities and climate change mitigation and adaptation requirements".

Key Result Areas

- **Improved data collection, information sharing, and education awareness**
- **Policy & Regulation** - Policies and regulatory frameworks developed and implemented.
- **Best Practices** - Enhanced private sector engagement and infrastructure development implemented
- **Human Capacity** - Enhanced human capacity

Our Regional Organics Project

Organic material is biodegradable matter such as kitchen scraps (food); garden cuttings, grass and branches; and paper. Combined data from 13 waste audits in the Pacific found that approximately 40% of waste disposal to our landfills and dumps is organics. When processed correctly (in an "aerobic" or oxygen-filled environment), organic materials can produce valuable nutrient rich products, such as compost, suitable for soil enhancement and food cultivation. However, when intermingled with other waste and disposed in a landfill or dump (an "anaerobic" environment), organic material can release toxic leachate and generate methane gas.

The purpose of this regional project is for Pacific stakeholders, now and into the future, to have practical and resources and decision-support needed to design and implement their own effective organics management solutions, appropriate for their own context and communities. Fiji, FSM, RMI, and the Solomon Islands have chosen organics as a priority or secondary priority of their PacWastePlus country project. The Organics regional project will review existing Organic facilities from the region, undertake technical research, and adopt findings and resources from Country Projects to develop:

- a "Minimum Standard" technical framework for countries to have as a resource when designing and operating their own organics processing facility
- a "decision guidance resource/tool" – to guide informed decision making around processing system design/ technologies, size and equipment requirements, operational processes, etc to suit any context and scale
- on-line training package to guide the application of "decision guidance resource/tool"
- resources to communicate with and empower communities to convert their organic "waste" to a valuable "resource" using appropriate solutions available (i.e., backyard, on-farm, community-level, or national-level organics processing).

Learn more about our regional organics management programme by visiting

https://pacwasteplus.org/regional-project/organics-management/

For more information please contact:

The PacWastePlus team on pwp@sprep.org

Or visit - www.pacwasteplus.org

(post project please email-sprep@sprep.org)

Disclaimer

This publication was produced with the financial support of the European Union. Its contents are the sole responsibility of SPREP and do not necessarily reflect the views of the European Union.

ISBN 978-982-04-1190-6