Acorn Bioenergy Operations Ltd

Waste Minimisation review Devon AD Plant

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1. Introduction

This Waste Minimisation Review (WMR) is written to cover the scope of operations for Devon AD Plant, Hide Market Road, Willand, Devon, EX15 2FP (the Site) operated by Acorn Bioenergy Operations Limited (ABL) (the Operator).

The WMR has been written to support the environmental permit application for the proposed site, which requires a bespoke installation permit. It is a live document that will be reviewed annually.

The proposed anaerobic digestion (AD) facility will process biodegradable wastes, generating renewable biogas and nutrient-rich digestate for agricultural application. This WMR has been prepared to demonstrate how the proposed anaerobic digestion facility will minimise the production of waste, optimise the use of raw materials, and operate in accordance with the principles of the waste hierarchy and Best Available Techniques (BAT).

2. Feedstock Inputs and Waste Streams

Table 1 below provides an overview of the projected waste and crop (non-waste) feedstocks for the AD plant. The proposed feedstocks include several non-hazardous liquid wastes which may be used to replace liquid process water.

Table 1 Feedstock description, source, form, storage location, and approximate annual throughput

Feedstock description	Source(s) of feedstock	Waste code	Form	Storage location	Approximate tonnes treated per year
Whole crop Silage	Energy crop	Not applicable	Solid	Silage clamp	15000
Maize Silage	Energy crop	Not applicable	Solid	Silage clamp	25000
Oat Pellets	Energy crop/ crop residue	Not applicable- residue	Solid	Silage clamp	3780
Grass	Energy crop/ crop residue	Not applicable- residue	Solid	Silage clamp	6200
Straw (humid bales) - treated	Energy crop/ crop residue	Not applicable- residue	Solid	Silage clamp	12400
General Grain	Energy crop/ crop residue	Not applicable- residue	Solid	Silage clamp	4400

Feedstock description	Source(s) of feedstock	Waste code	Form	Storage location	Approximate tonnes treated per year
Chicken manure	Local farms	02 01 06	Solid	Manure Reception Building	14000
Pig slurry	Local farms	02 01 06	Liquid	Liquid Feedstock Tank	10000
Cattle slurry	Local farms	02 01 06	Liquid	Liquid Feedstock Tank	10000
Non-hazardous liquid wastes	02 03 liquid wastes	02 03 01 02 03 04 02 03 05	Liquid	Liquid Feedstock Tank	To replace process water volume as a contingency
	02 04 liquid wastes	02 04 03			
	02 06 liquid wastes	02 06 01 02 06 02			
	02 07 liquid wastes	02 07 01 02 07 02 02 07 04 02 07 05			
Dirty water	Dirty water from on-site drainage systems	Not applicable	Liquid	Process water lagoon and Process water tank	20,000
Liquid separated	From the AD process	Not applicable	Liquid	Separated liquid holding tank	25550
				Total	**146330**

The manures, slurries and non-hazardous liquids are all classified as waste but provide value as feedstocks for renewable energy, effective treatment and sanitisation and nutrient recovery to replace manufactured fertilizer use.

Crops are ensiled on site and stored within the silage clamps. Ensiling the crops allows fermentation to take place, whereby lactic acid bacteria convert sugars in the crop material into lactic acid. This lowers the pH (typically to ~3.8–4.2), inhibiting spoilage organisms and preserving the crop, ensuring high biogas yield even after months of storage. The use of ensiled crops will enable the AD facility to operate continuously and efficiently throughout the year.

3. Justification for Waste Use

The selection of waste feedstocks for the anaerobic digestion (AD) process is based on their availability, suitability for biogas production, and compatibility with environmental and agricultural sustainability objectives. Each of the chosen waste streams—primarily manures, slurries, and non-hazardous liquid waste offers a valuable source of organic material and nutrients while supporting the diversion of biodegradable waste from traditional disposal routes. The selected waste streams:

- Are locally available agricultural and food sector residues.
- Offer high methane yields relative to their availability.
- Provide an environmentally beneficial alternative to direct land spreading or disposal.
- Support circular economy objectives through energy and fertiliser recovery.

Replace the use of mined and chemically produced fertilisers.

4. Process Outputs

The main process outputs from the anaerobic digestion process are as follows:

- Biogas (used for heat and power generation or grid injection); and
- Digestate liquor and fibre (applied to agricultural land as organic fertiliser and soil conditioner)

By converting all outputs into usable energy and digestate for land application, the system supports closed-loop waste management.

5. Raw Materials Use and Minimisation Opportunities

The anaerobic digestion facility employs a range of techniques to ensure the efficient and responsible use of raw materials.

Table 2 details the anticipated raw materials that will be used on Site, with associated raw material usage efficiency strategies:

Table 2 Raw materials and efficiency strategies

Raw Material	Purpose	Efficiency Strategy
Sulphuric acid	Scrubber chemical for NH_3 abatement	Use of dosing control systems; acid dosing is variable based on measured ammonia levels in the air extracted. Usage is controlled and minimised to prevent waste.
Ferric hydroxide	H_2S control in digesters	Optimise dosing rates using H_2S sensor feedback
Diesel	Site vehicles and backup generator	Use energy-efficient vehicles; minimise idling

Ad-Blue	NO_x emission reduction in vehicles	Maintain efficient engines; use only when necessary
Glycol	Frost protection in water systems	Use in closed-loop systems only; monitor for leaks
Fresh oil	CHP lubrication	Scheduled maintenance to avoid overuse; use oil reclamation/recycling if feasible
Activated carbon	Biogas scrubbing	Optimise changeout intervals based on performance; regenerate where possible
Cooking oil (anti-foam)	Prevent foaming in digesters	Use only as needed based on foaming observations should they occur. Unlikely with the feedstocks to be used.

Overall, raw material usage is continuously reviewed as part of the site's Environmental Management System to identify opportunities for substitution, reduction, or recovery in line with Best Available Techniques (BAT) and resource efficiency principles.

6. On-Site Waste Generation and Handling

Although the anaerobic digestion (AD) process is designed to maximise resource recovery and minimise waste, some ancillary waste streams are unavoidably generated through normal site operations and maintenance activities. These wastes are managed in accordance with regulatory requirements and the site's Environmental Management System (EMS), with a focus on safe storage, segregation, minimisation, and appropriate off-site recovery or disposal via licensed contractors. Table 3 details the main types of waste generated on-site and the strategies in place for their effective handling.

Table 3 Site waste management techniques

Waste Type	Origin	Management
Feedstock contamination	Incoming deliveries	Segregated and sent to licensed waste handlers
Spent activated carbon	Carbon filters	Collected and sent for regeneration or disposal
Used oils and lubricants	CHP units and machinery	Collected by licensed contractor for recovery

Contaminated rags, PPE, packaging	Maintenance and chemical storage	Stored in designated bins; disposed via licenced routes

No liquid effluent (other than treated digestate) is discharged from the site.

7. Digestate Management

The site is designed such that the digestate produced is compliant with the requirements of BSI PAS110: 2014 Specification for whole digestate, separated liquor, and separated fibre derived from the anaerobic digestion of source-segregated biodegradable materials.

Digestate liquor is a rich source of nitrogen, phosphorus, potassium, and trace elements which is stored and used to replace the use of manufactured fertiliser. The digestate fibre is a very good source of organic matter as well as supplying valuable nutrients and will be used primarily as a soil improver.

Digestate will be managed in accordance with the digestate management plan.

8. Monitoring and Continuous Improvement

To ensure the ongoing effectiveness of waste minimisation measures and the overall environmental performance of the anaerobic digestion facility, a structured programme of monitoring and continuous improvement will be implemented. This approach is consistent with Best Available Techniques (BAT) and is embedded within the site's Environmental Management System (EMS).

The following measures will support proactive management, performance tracking, and regular review of site operations:

- Raw material usage and waste production are recorded monthly and reviewed annually.
- Opportunities for reduction, substitution, or recovery are continuously assessed.
- Maintenance schedules ensure efficient operation of chemical dosing and gas treatment systems.

9. Conclusion

The proposed AD facility is designed to be a resource-efficient, low-waste process that aligns with the waste hierarchy and BAT principles. All waste streams are either processed into usable products or managed through established, compliant routes with minimal environmental impact. Ongoing review will ensure that waste minimization remains a core part of site operations and environmental performance.