Snapshot Report

AMPC
AUSTRALIAN MEAT PROCESSOR CORPORATION

V&V Integrated Waste Management

Integrated Wastewater Treatment, Biogas and Biofertiliser FEED

Project Code
PIP2021-1226

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Project Description

V&V Walsh is the largest meat processor in Western Australia, employing more than 1000 staff and producing more than 40 million kg of meat products annually. The Bunbury facility can process 5,000 sheep per day, approximately half of this is boned and packed on-site. In addition, it can process a further 400 cattle per day, with the ability to bone and process 300 beef carcasses per day.

The processing plant, operating since 1993, is located adjacent to the Preston River, and close to environmental conservation areas. In recent years, the environmental regulation has become increasingly stricter, both regarding the amount of water that can be disposed via irrigation, and the nutrients loading (nitrogen and phosphorous). In the past five years several attempts to improve the existing system weren't entirely successful, mainly due to the current wastewater treatment plant (WWTP) configuration, designed for the removal of organic matter, but not nutrients.

Following a series of technical assessments, including sampling campaigns and Biowin modelling, the conclusion was that to achieve compliance with the regulation, a new WWTP is required, focussing on the removal of nitrogen. This is a challenge facing the red meat industry across the board, and several processing plants are going through a similar process. The new treatment process needs to achieve efficient nitrogen removal, combined with an improved water quality, so it becomes suitable for uses in other applications other than irrigation.

In the other hand, abattoir wastewater is a rich source of valuable nutrients, energy, and water . When appropriately managed, and integrated with selected streams of organic wastes, optimised anaerobic digestion and resource recovery can be achieved, along with robust long-term environmental compliance, along with side-streams revenue.

Implementing the concept of integrated management of wastewater and organic wastes will future-proof the company's operation in terms of environmental compliance, potentially generating income from side-streams, such as energy, water, and fertiliser.

This Final Report presents the outcomes of the Front-End Engineering Design (FEED), V&V Walsh's Integrated Wastewater Treatment, Biogas and Biofertiliser plant. The integrated design was conceived based on the concepts of approaching Net Zero Carbon, via resource recovery and a circular economy.

In this concept, the liquid streams were processed in the modular wastewater treatment plant (WWTP), aiming for recovery of oil & grease, solids and organic matter, nitrogen, phosphorous and pathogens. The technology selection was based on maximising the recovery of recycled water, combined with optimised biogas production. This is possible using a sequence of secondary/tertiary and advanced water treatment technologies, allowing for unrestricted irrigation and other non-potable uses.

In parallel, carbon-rich solid waste streams, including paunch, save all screened solids, manure, sludge, and fat from WWTP, are diverted to an anaerobic digester (AD), aiming to produce biogas and bio-fertiliser. This prevents the WWTP from being overloaded by BOD/COD, which could increase the aeration requirements, whilst still preserving sufficient carbon for the denitrification process to take place efficiently. This brings along opportunities to reduce costs by reducing aeration and external carbon requirements, and where possible, redirect carbon to energy-generating processes. The concept plant will allow for flexibility for solid and liquid waste received and pre-treatment to achieve an adequate mixing ratio, consequently higher methane yield offsetting energy consumption by the WWTP.

Figure 1. Proposed Integrated Wastewater Treatment, Biogas and Biofertiliser plant at V&V Walsh processing plant in Bunbury, WA.

This project is aligned with the Australian red meat and livestock industry target to achieve Carbon Neutrality by 2030 (CN30) [1] and will bring V&V Walsh to the forefront of the industry, as a model to be implemented by other red meat processing plants (RMPs).

Cost Estimate and Economic Analysis

The total capital expenditure (CAPEX) based on a +/-30% cost estimate is of $16.5M. The investment is planned to occur in stages, over 5- 6 years, as per suggested on Table 1:

Table 1. Summary of estimated capital investment over the next six years.

		2022	2023	2024	2025	2026	2027	2028
Stage 1 – Wastewater treatment plant	$7.31M							
Stage 2 – Biogas Plant	$5.95M							
Stage 3 – Biofertiliser plant	$3.37M							
Total	$16.63M							

[1] www.mla.com.au/research-and-development/Environment-sustainability/carbon-neutral-2030-rd/cn30

The streams generating revenue, based on conservative assumptions, are presented on Table 2:

Table 2. Summary of revenue streams.

Income	Start	$/annum
Recycled water	2024	393,600
Energy From Biogas (Combined)	2025	989,250
Biochar	2027	523,200
Savings from disposal	2027	875,000
Carbon credits	2028	177,600
Total revenue per annum		**$2.96 M**

The economic analysis (using the Net Present Value method) considered the capital expenditure, Operating costs based on a percentage of CAPEX, and the estimated incomes. The outcome is net positive, over a 25 year's total project life, with a Net Present Value of $28.9M. The payback time is estimated to be 10 years, with an annual ROI of 2.7%. Table 3 presents the summary of the Economic Analysis of the implementation of the Integrated Waste Management system.

Table 3. Summary of Economic Analysis of the implementation of the Integrated Waste and Wastewater Management system.

Item	Value
Net Present Value	$ 28,9 M
PV of Costs (CAPEX & OPEX))	$ 30,3 M
ROI 25 years	95.4%
Annualised ROI	2.72%
Payback time	~10 years

Project Content

This project consisted on the development of a front-end engineering design of integrated wastewater treatment, biogas and biofertiliser plant. The concept to be used in the design considers engineered biological reactors for adequate management of wastewater and organic solid waste originated from the abattoir processing plant.

This design is for a new optimized and modular wastewater treatment plant with high flexibility of process control, focusing on attending current wastewater disposal issues faced by the abattoir. Design upgrades of the existing infrastructure will not be considered and the decommissioning of such infrastructure, existing ponds, was purposed after the implementation of new designed WWTP.

The new plant design is considering aspects such as nutrients (N, P) and other compounds removal from wastewater, with the possibility of irrigation and other water recycling uses (either Class C or Class A), within compliance. Additionally, the design of an integrated biogas plant will allow organic solid waste (currently disposed of off-site) and sludge from the WWTP, to be processed on-site for biogas production with potential for thermal and electrical energy applications. The incorporation of a biofertiliser plant design will consider upgrades of the digestate (resulting from the biogas plant) for conversion into an added value fertiliser product.

The result of this project, including the cost estimates for the plants, will then be used by V&V Walsh for the decision-making process for further stages of the plant implementation. These results will also support the Environmental Licensing application process. The proposed system has never been trailed in the Australian Red Meat Processing Industry and represents a quantum leap in terms of innovation and resource recovery.

The overarching objective of this project is to prepare a front-end engineering design for an integrated wastewater, biogas and fertiliser plant for management of the abattoir wastewater and organic solid waste. The final report was used for the licensing application, decision making process, procurement related to this and further stages of the system implementation. The objectives to be achieved include:

- Introduce to the Red Meat Processing Industry a new concept of recovering value from wastewater and organic solid wastes
- Development of a design of an Integrated Wastewater, Biogas and Biofertiliser plant
- Preparation of an equipment list to be used in the procurement stages
- Development of a cost estimate for the wastewater, biogas and biofertiliser plants
- Development of an economic analysis including CAPEX and OPEX, which will support the decision-making process for the plant implementation.

Project Outcome

Abattoir wastewater is a rich source of valuable nutrients, energy, and water. When appropriately managed, and combined with selected streams of organic wastes, optimised anaerobic digestion and resource recovery can be achieved, along with robust environmental compliance. Implementing the concept of integrated concept to V&V Walsh wastewater and waste management will future-proof the company's operation in terms of environmental compliance, aligned with the concepts of circular economy and resource recovery.

The schematic flow diagram in Figure 2 provides a high-level description of the integrated processes. The concept proposed includes pre-conditioning and treatment for liquid and solid waste streams.

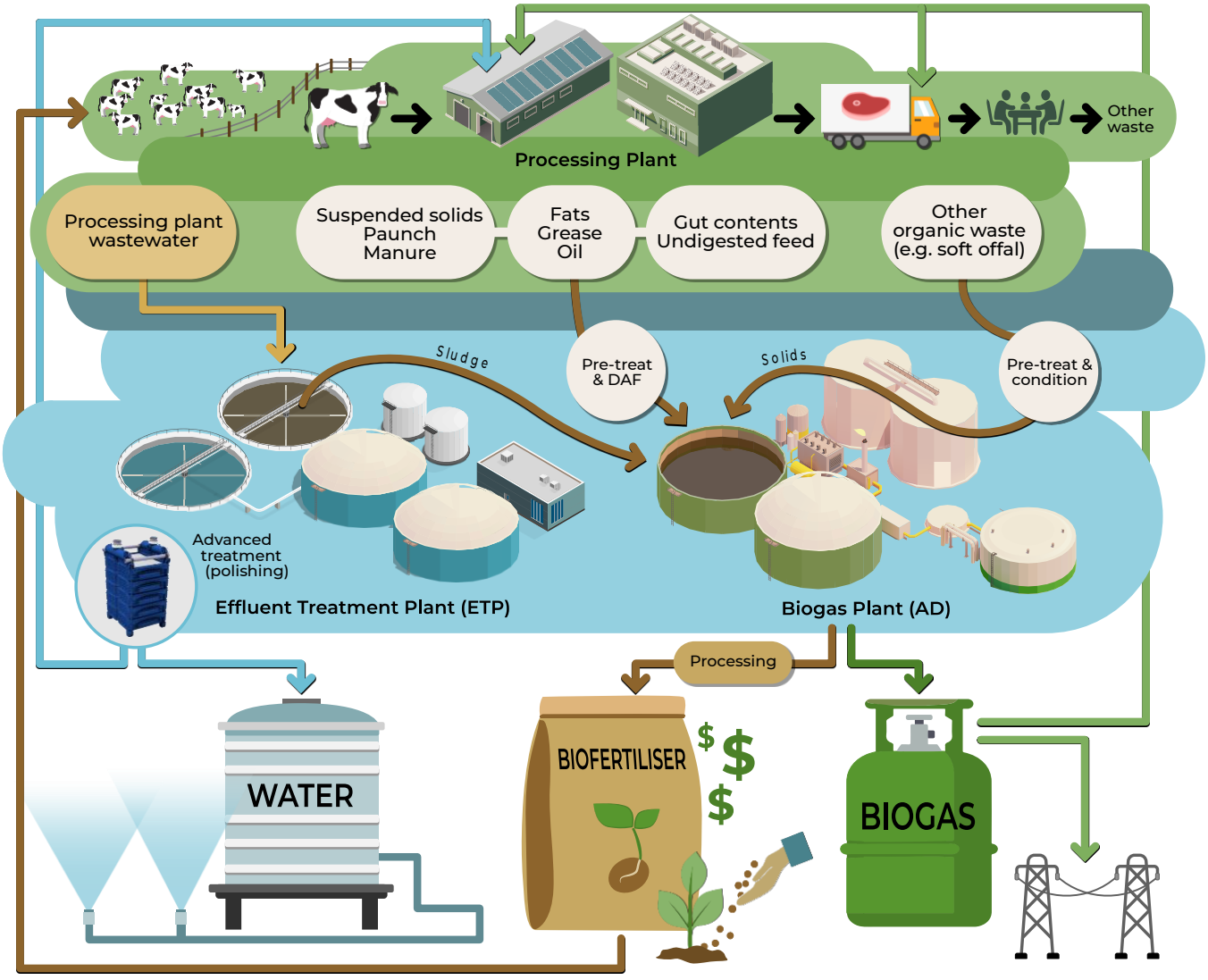

Figure 2. Schematic model of the V&V Walsh Integrated Waste Management system. ©Tessele Consultants.

This is also contributing to the Australian red meat and livestock industry ambitious target to be Carbon Neutral by 2030 (CN30) and will bring V&V Walsh to the forefront of the industry, as a model to be implemented by other red meat processing plants (RMPs).

In this context, the Concept Design proposed for this project has taken into consideration the production of recycled water compliant with medium and high exposure quality, and production of biogas and fertiliser from mixed solid waste streams from V&V Walsh Abattoir. The process integration, along with resource recovery and combining the treatment of both solid and liquid streams is an innovative concept in the Australian red meat industry resulting in positive environmental, economic, and social outcomes.

In this concept, the liquid streams will be processed in the modular wastewater treatment plant, aiming for removal of oil & grease, solids and organic matter, nitrogen, phosphorous and pathogens. For the technology selection it was considered the recovery of recycled water. This is possible using a combination of secondary/tertiary and advanced water treatment technologies allowing V&V Walsh to irrigate and find alternative end-users for the treated water.

Selected solid waste streams, including paunch, save all screened solids, manure, sludge, and fat from WWTP, will processed in an anaerobic digester (AD), aiming to produce biogas and bio-fertiliser. The plant will allow for flexibility for solid and liquid waste receival and pre-treatment to achieve adequate mixing ratio, consequently higher methane yield offsetting energy/gas consumption from the WWTP.

Benefit for Industry

Based on the technical and economical outcomes presented in this report, the implementation of the Integrated Waste and Wastewater Management system will result on:

- The integrated system is self-sufficient in terms of power, the entire system can be powered by biogas, with a surplus of energy in the form of heat
- The income generated by side-streams will offset costs (CAPEX and OPEX). The estimated return on investment is 2.7% per annum, when traditionally waste/wastewater management is a cost (negative ROI).
- The biogas system is designed to receive additional feedstock, with a potential to double the energy output by adding high carbon wastes (such as food waste, breweries waste, etc.).
- The methane produced in the biogas system can be used for producing Hydrogen if that is desirable.
- The facility will offset carbon, contributing for V&V Walshe’s net zero carbon programme.

Useful resources

Not applicable.