final report

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GAS CONSUMPTION REDUCTION IN A RENDERING PLANT

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Executive Summary

This report summarises the natural gas reduction project in terms of energy and greenhouse saving.

The achievement criteria of the milestone specific to this report are:
Evaluation of gas and electricity consumption post project implementation. Prepare final report on project containing details of energy and greenhouse savings and improved plant capability. This will be carried out using existing utility metering infrastructure. The initial estimates used in the PIP application were as follows:

Table 1: Savings estimates from initial PIP application

Savings	Gas %	Electricity%	tCO2-e %
Rendering plant efficiency improvements	33	-	31
Boilers Efficiency Gains	22	78	26
Biogas Use in Boilers	39	-	36
New Blood Dryer	2	22	4
Biofilter Installation	4	-	4

The boiler efficiency and rendering plant feed separation projects do not appear to have achieved the savings initially expected. However, biogas generation rates appear to be slightly above forecast values, so once the biogas treating system is fully operational and bio-methane can offset natural gas use in the boilers, higher savings may be achieved than originally forecast for biogas use.

To further reduce natural gas consumption, the two main areas to concentrate on are:
1. Reduce water entrainment in cooker feed material and blood as much as possible
2. Further enhancement of the steam system efficiency, such as steam trap maintenance, flash steam recovery, TDS control of blowdown, enhanced condensate recovery, steam and condensate return pipework lagging

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1 Background

This project was undertaken to reduce gas consumption in the rendering plant and thus reduce the monthly gas bill of the site.

2 Projective Objectives

2.1 Project Objectives

As the project title suggests, the overall aim of this project was to reduce gas consumption in the rendering plant, including boiler fuel consumption. It identified a number of specific projects which could meet this objective, which are outlined in the following section. They involved redesign of the rendering process to eliminate bottle necks, improvements to the efficiency of the blood processing system, enhancement of odour capture and change from current odour management system to biofilter, boiler efficiency improvements and capture and use of biogas in the boiler.

The specific objectives were:

- Developing company capability in the management of innovation, specifically in this case the assessment of potential new technologies in addressing operational needs at the facility in relation to improving and optimising the rendering plant.
- Identify the optimal layout and design of the cooking process involving the carcase material (cooked meat, bone and offal waste) pressing equipment, meat meal milling and handling equipment;
- Identify the optimal layout and design of the blood drying processing equipment;
- Identify the optimal layout and design of odour management system based on spacial limitations, including the development of a rendering odour inventory;
- Identify the optimal configuration and design of the new higher-efficiency boilers fuelled in part by biogas captured from the covered anaerobic lagoon (CAL) waste water treatment system;
- Quantify the energy and CO2 savings that will arise from each of the initiatives listed above; and
- Quantify the costs associated with each of the initiatives listed above

2.2 Project Milestones

The relevant milestones were:

No	Milestone
1	Connection of existing steam meter data for the collection of baseline steam data
2	Design and costing of the biofilter and conduct odour rendering inventory.
3	Engage firm to finalise design and costing for the press area, milling and meal handling and blood drying.
4	Evaluation of gas, electricity consumption post project implementation. Prepare final report on project containing details of energy and greenhouse savings and improved plant capability.

The results of milestones 1- 3 were incorporated into the projects which were implemented and are assessed in this report in terms of their energy and greenhouse savings.

3 Methodology

3.1 Initial estimates

The initial estimates of savings that were included in the PIP document were as follows:

Table 2: Savings estimates from initial PIP application

Savings	Gas %	Electricity %	$tCO_{2\text{-}e}$ %
Rendering efficiency	33	-	31
Boilers Efficiency Gains	22	78	26
Biogas Use in Boilers	39	-	36
New Blood Dryer	2	22	4
Biofilter Installation	4	-	4
Total Savings			

From the above table it can be seen that 39% of the natural gas savings came from biogas use in the new boilers, 33% came from the rendering efficiency project and 22% from the higher efficiency of the new boilers.

3.2 Project implementation

Improvements installed in the rendering plant as part of the outcomes of this project include:

1. Reorganisation of rendering plant, which required changes of the material handling systems (both pre and post-cooker). Equipment downstream of the cooker includes new presses, hammer mill and storage bins as well as auxiliary material handling and transfer equipment.

2. Boiler efficiency gains – replace existing boilers with dual fuel boilers (natural gas and biogas). New boilers will include enhanced efficiency measures such as high efficiency burners and a cutting edge computer controlled monitoring and operating system to ensure maximum efficiency.

3. Blood cooking – install a new blood storage tank, new coagulation system, new transfer pumps and high efficiency dryer.

4. Biofilter installation – install biofilter to capture and treat point-source discharges, such as cookers, presses, screw conveyor, meal milling /handling and blood system. This project included a detailed odour inventory of the rendering plant, which covered the cooking processes (cookers, cooker surge bin), presses, blood processing, raw materials bin/hogger and other related processes, including the waste water treatment plant. This replaced the existing odour treatment system, which consumes natural gas.

5. Biogas use – use of biogas for co-firing in new boilers.

3.3 Data available for analysis

The data available for the analysis included:

- Weekly natural gas consumption and production data
- Electricity use data by separate meters
- Biogas metering data

4 Results

4.1 Natural gas use

Using the data used in the initial PIP application as outlined in the table below, the 3 major users of natural gas are the boiler, the blood dryer and the odour burner. It is useful to assess the project by the impact it will have on key performance indicators at full production. It is important to keep in mind that less than full production rates will lead to higher KPI values, due to the fixed proportion of consumption. For example, boiler losses on startup and shutdown and energy costs associated with cleaning are the same, regardless of how much production takes place.

The original KPI for natural gas was about the industry average. Once all projects are implemented, the KPI should be substantially below the industry average. The data from the 2014-2015 year to date indicates that the additional efficiency measures which were not identified in the original scope of work have provided additional savings.

Further details on the savings of each project are outlined in the following sections.

4.2 Electricity use

An investigation of the proposed projects and their impact on the key performance indicator for electricity use is indicated in the following table. Using the data used in the initial PIP application, the original KPI was about the industry average. After the projects were installed, the KPI should have been below the industry average. It is necessary to investigate the changes to the consumption through the individual meters feeding the plant.

4.3 New boiler project

The new boilers were installed during a shutdown. The original quote used in the savings calculations was from one company, however, that company was not used. Therefore, the savings can be expected to be slightly different to the initial projections. Normally a site would use the supplier that provided a cheaper quotation, and part of the reason for the cheaper quotation could be that the boiler is less efficient and does not have more costly energy saving devices. It is an analogous situation with motors – high efficiency motors cost more but save more during their operation due to lower running costs. It is therefore not accurate to compare expected savings from the initial quote with the installed boilers, as they were from a different supplier. Rather, they could be considered an upper limit for the savings achievable. Based on the analysis, it appears that about 25% of the original natural gas savings have been achieved. There would appear to have been savings in electricity, at least at the amount that was estimated in the initial PIP.

4.4 Blood processing project

The blood processing project at least achieved the expected natural gas savings. In theory, it would not be possible to achieve higher savings than initially calculated, so some of the additional savings may be due to the boiler efficiency project. The electrical savings were at least equal to those calculated in the initial PIP.

4.5 Rendering plant efficiency improvements

Savings from the project were expected to start after the final installation. From the actual natural gas consumption, it can be seen that it appears that actual savings achieved are about 10% of the initial forecast. This is possibly due to the fact that the same load of water is being evaporated from the cookers, and most of the heat use in cooking (about 90%) is used to evaporate the water from the render feed material. Therefore, the overall stream savings will not be the same, as the heat load on the cookers is the same and the efficiency of the cookers is the same.

4.6 Biogas use project

Biogas use was trialled but had to be suspended due to operational problems. Only a portion of the biogas produced during each week was used, the remainder was flared. Metering data from biogas production indicates that close to 30% of natural gas use could be offset by biogas use at current natural gas usage rates once the biogas pretreatment is fully operational. This is consistent with industry benchmarks.

5 Discussion

5.1 Biogas generation (forecast vs actual)

The initial estimate is lower than the actual biogas production. The higher biogas generation rates compared to forecast are possibly due to a number of factors, such as

- Higher than 80% degradation of COD in CAL
- Higher than 90% capture of biogas generated
- Higher COD load into CAL, possibly due to unrepresentative COD sampling of inlet stream

It is useful to look at the biogas generation factor relative to production. This will decrease if changes are made to reduce the COD load on the CAL, if less than 90% of the biogas generated is captured or if a lower percentage of COD is degraded in the CAL.

Table 3: Biogas generation factor, compared to production rate

Factor	GJ biomethane/ tHSCW	
From NGER Wastewater Method 1	0.710	Assumes 80% COD removal in pond, 90% capture of biogas and COD load of 83.57 kg COD/tHSCW

The observed methane percentage of the biogas is 70%, which is consistent with the estimate used in the forecast.

5.2 Energy and Greenhouse Balance

Saving to date have been less than forecast, largely due to the boiler efficiency and rendering plant efficiency projects achieving less savings than originally forecast.

Table 4: Energy and greenhouse savings to date

Project	% of gas total	% of elect total	% of $tCO_{2\text{-}e}$
Rendering efficiency	6%	-	6%
Boiler efficiency gains	17%	78%	26%
Biogas use in boilers	64%		53%
Blood dryer replacement	4%	22%	7%
Biofilter installation	9%		8%
% savings vs forecast	51%	100%	52%

5.3 Energy and Greenhouse savings projections

The following table includes the projections once biogas use is optimised.

Table 5: Revised forecast, energy and greenhouse savings

Project	% of gas total	% of elect total	% of $tCO_{2\text{-}e}$
Rendering efficiency	4%	-	4%
Boiler efficiency gains	11%	78%	17%
Biogas use in boilers	76%		69%
Blood dryer replacement	3%	22%	5%
Biofilter installation	6%		5%
% savings achieved vs forecast	76%	100%	78%

6 Conclusions/Recommendations

1) Once biogas is optimised and has been operating for some time, the natural gas savings and subsequent greenhouse gas savings should be verified.
2) The boiler supplier should be contacted to confirm forecast savings vs actual achieved
3) A company (such as Spirax Sarco) should be consulted to identify additional boiler and steam system efficiency options available (eg flash stream recovery, automated TDS control of blowdown, hot water heat exchanger stall prevention, status of steam traps, status of lagging on steam and condensate return lines, degree of condensate return, operator training etc.)
4) To further reduce the load on the rendering plant cookers, every effort should be made to reduce the amount of water entrained in the feed material, as evaporating water consumes most (90%) of the energy in the render cooker process. A trial could be made of redirecting water which drains off the raw material feed bins back to the CAL, as long as it does not include any solids materials.
5) In future, a more detailed M&V plan, which includes submetering before and after project installation, should be included in the project proposal, to make it easier to verify savings. For example, if the additional boiler and steam efficiency options outlined above are to be considered, it may make sense to include them in an energy performance contract package, which would guarantee the savings and M&V would be included.

7 Key Messages

Key messages from this report are

1) The significant contribution which can be made to reducing natural gas consumption and greenhouse emissions by using biogas generated in anaerobic ponds
2) The value of assessing energy use and efficiency in the rendering plant, which is a significant user of thermal energy
3) The importance of measurement and verification as part of project planning