FINAL REPORT

2020 Environmental Performance Review (EPR) for the Red Meat Processing (RMP) Industry

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1.0 EXECUTIVE SUMMARY

This report continues this series of industry environmental performance reviews for Australian Red Meat Processors which began around 20 years ago. This 2020 review presents results for the 2019/2020 financial year. AMPC contacted Australian red meat processing businesses and invited their voluntary participation in this project.

Sites were sent a survey in *Microsoft Excel* format, with completion supported by a webinar, workshops, and telephone & email discussions. During data collection, extensive data quality assessment was required, with apparent incorrect responses clarified with the site with the assistance of the Energetics *Energy and water benchmark model for a red meat processing plant.*

In total, responses were obtained from 26 sites, with complete data sets received for 25 of those. This is a significant improvement in the sample size from the 2015 EPR, where 14 responses were received with also 14 in 2010, ten responses in 2003, and 9 responses in 1998. This is an encouraging result, showing that sites may be taking a greater interest in sustainability and seeing the need to allocate more resources to documenting emissions and energy, water, and waste intensity.

Of the approximately 150 red meat processing facilities operating in Australia over all scales and species, although the 26 responses represent 17.3% of the total number of businesses, however contribute 41.3% of the 3,464,022 t HSCW for all red meat production reported from July 2019 to June 2020 by ABS series 7218013, being a good representative (with some skew towards medium and large scale processors) of industry performance relative to previous surveys.

The following conclusions were made regarding the processing sector's environmental performance from the data gathered in this survey:

1. Water use intensity was 7.9 kL / t HSCW. Compared to the last EPR in 2015, where a result of 8.6 kL / t HSCW was reported, this shows a reduction of water use intensity of 7.9% or 0.7 kL / t HSCW. Considering the 2008/2009 FY EPR where 8.7 kL / t HSCW was reported, this shows that the Australian red meat processing industry is continuing to achieve reductions in water intake.

2. The average site wastewater discharge volume calculated was 6.5 kL / t HSCW, a significant improvement of 2 kL / t HSCW on the 2015 figure of 8.5 kL / t HSCW, or 23.5%. Relative to the intake, this survey calculated 83% of water intake being discharged, compared to 99% in 2015. This suggests significant improvements in in-plant water usage.

3. The energy use intensity calculated in this survey was 3316.2 MJ / t HSCW, or a total increase of 10.4% compared to the 2015 value. The energy value associated with rendering was 1,223 MJ / t HSCW, meaning that for this sample size and excluding rendering the energy use intensity is 2092.9 MJ / t HSCW, or a 43% increase on the 2015 figure.

   This figure should be considered in the context of energy performance over time, where 2008/2009 energy intensity was 4,108 MJ / t HSCW. In addition, if the 2020 reduction in waste water discharges are partly attributable to improvements in waste water management, this may come at a cost to energy intensity.

4. On average, total site GHG emissions were 397 kg CO_2-e / t HSCW, an 8.1% reduction compared to the 2015 value of 432 kg CO_2-e / t HSCW.

5. The average figure for waste sent to landfill in this EPR was 11.9 kg / t HSCW, a very large increase of 102% compared to the 2015 value of 5.9 kg / t HSCW. Sites in this EPR reported a wider scope of wastes sent to landfill, whereas the 2015 figure was calculated for only solid waste sent to landfill. Sites did not break down the components of their general waste, however large volumes of liquids (e.g. waste oil, non-renderable blood, un-dewatered paunch) sent to landfill are believed to have skewed these results. Due to increases in state based landfill levies, it is not consistent with expectation that the processing sector has increased tonnages of wastes disposed to landfill. The context of the COVID period should also be considered here, where the demand for non-recyclable face masks, gloves, sanitizer, and wipes would have contributed to additional landfilled waste.

6. Noise complaints were reported to be comparatively rare, at far below 1 per site per year. Of the 25 sites, only one reported receiving two noise complaints from a residential source. This continues the positive trend observed in the 2015 EPR of receiving very few noise complaints.

7. Odour complaints are relatively more common than noise complaints, with on average 3.8 per site per year reported, however a 46% reduction for 2019/20 was achieved compared to 2015, where 7.1 odour complaints per site per year were recorded, showing that the processing sector is making good progress in reducing odours.

The sample size of 25 processors across multiple states and large species only and mixed species processing encompasses 41.3% of annual HSCW tonnage throughput, with a good spread between smaller plants with a general trend towards medium to large plants. There was no significant evidence that plant size impacted environmental performance indicators, thus the results presented here are considered representative of the industry as a whole. As previously mentioned, the calculated performance indicators of the industry presented herein may be best interpreted in isolation and not rigorously compared to previous EPRs, due to the significantly greater response rate increasing the potential for outliers.

Large variation in responses between sites is indicative of the complex nature of managing resource and asset efficiencies in red meat processing, and also suggests that there is still room for improvement in future survey response & participation, as well as improvement in environmental performance across the entire processing sector.

There was little significant benefit demonstrated in the calculated performance indicators that was attributable to formal energy, water, emissions, or waste reduction targets. This suggests that these targets need to be further developed in-plant, with additional resources allocated towards monitoring and achieving these KPIs. One such way that the efficacy of these targets may be improved is by directly making higher management responsible for reductions in energy, water, emissions, and waste from meat processing or further incentivizing in-plant staff for the achievement of these targets.

The data collection for this project depended on voluntary participation of red meat processors and their capacity to supply data. The quality of responses existed on a spectrum, where it was apparent that some sites had better data systems than others, and even some sites within the same business outperformed others and had differences in environmental performance targets and achievements. This suggests that the environmental KPI targets are either left to individual sites, not clearly communicated, or not effectively incentivised.

With regards to the industry wide goal of CN30, there is a clear downward trend in the emissions intensity per business metric since 2009, however the rate of emissions reduction must accelerate via more invasive and proactive actions in order to progress towards carbon neutrality, noting that complete 'carbon neutrality' for processors will likely require some carbon emissions offsets or abatement.

2.0 INTRODUCTION

The red meat processing industry makes an important contribution to rural and regional Australia, being the largest food manufacturing sector as well as the largest food exporting sector. Continued improvement in sustainability has been identified by many as critical to the industry's future growth and success (AMPC, 2020). Energy, water use, and waste efficiency exist on a nexus and impact on production costs, profitability, competitiveness, and future business continuity. In some regions water availability is a potential constraint on industry operations and future expansion. In addition, the industry must meet community expectations about environmental sustainability, which includes limiting greenhouse gas (GHG), odour, and noise emissions and progressing towards the broad industry goal of carbon neutrality by 2030 (CN30). Reporting of environmental performance is also a requirement of some supply chain partners and is emerging in some export markets.

Environmental performance assessment in the Australian red meat processing industry is not new. Individual red meat processing plants work actively to improve resource use efficiency and environmental performance, guided by a portfolio of strategic research undertaken by AMPC (2013b). Industry-wide environmental performance reviews have been undertaken since 1998 at approximately 5 year intervals, with key reports published in 2011 (GHD, 2011), 2015 (CSIRO, 2015) and 2017 (All Energy Pty Ltd, 2017). These industry-wide reviews have been widely used for benchmarking individual performance and to support the development of applications for new and expanded red meat processing sites, most notably the ongoing work by Energetics to build energy and water benchmarking tools. The data have also been used to assess performance change over time, to support the development of industry policies, as well as for communication and training purposes.

This report continues this series of industry environmental performance reviews, presenting results for the 2019/2020 financial year. The results are broadly comparable to previous studies, in particular the previous EPR report of 2015 (Ridoutt, Sanguansri, and Alexander, 2015). Some important extensions to the methodology have been implemented to improve the inferences made when comparing performance between sites and over time. It is also important to note that this review concerns environmental performance, other factors contributing to the broader concept of sustainability, including economic, social, and animal welfare issues are excluded.

3.0 PROJECT OBJECTIVES

The objectives in collecting environmental performance data from the red meat processing sector include:

- Revise the key performance indicators calculated during the 2015 EPR used in the Australian red meat processing industry based on a review of industry sustainability and environmental reporting frameworks and consideration of environmental relevance
- Undertake statistical modeling to resolve differences in site environmental performance based on variation in animal mix and processes undertaken
- Assess critical variables having a major influence on environmental performance metrics
- Prepare an updated Environmental Performance Review of the red meat processing industry

4.0 METHODOLOGY

AMPC contacted Australian red meat processing businesses and invited their voluntary participation in this project. An incentive for participation was the offer of a session with the company managing the responses, All Energy Pty Ltd and the production of a customized report identifying opportunities for energy and water cost reduction based on their responses, and where plant initiated projects (PIP) projects may come from this. The Energetics benchmarking tool was also used to show comparative individual plant performance.

Sites were sent a survey in *Microsoft Excel* format, with completion supported by a webinar, workshops, telephone & email discussions. During data collection, extensive data quality assessment was performed, with response clarification where required, assisted by the Energetics *Energy and water benchmark model for a red meat processing plant.*

4.1 Key Inputs

4.1.1 Animal Mix

Throughput of cattle, lamb, pork, and other (goat, mutton, venison, veal) reported in head processed per annum, tonnes live weight where data exists, and tonnes HSCW were the key throughput inputs, supported by additional information on plant operations of rendering, hide processing, offal processing, boning, and trucking.

4.2 Energy Use

Processors reported their energy consumption over the various forms commonly seen in plants, from grid power, diesel for stationary energy and transport, coal (bituminous, sub-bituminous, and brown), natural gas for thermal and stationary energy, LPG for thermal and transport, fuel oil, unleaded petrol, biomass, biogas, and solar PV.

4.3 Water Consumption. Waste Water, and Waste Water Emissions

Water intake from town, bore dam, water body (e.g. lake or river), and rainwater, water recycling, any water efficiency targets, and volumes and destination of treated and untreated waste water. Where possible, nutrient analyses on waste water used to quantify nutrients (P, N, COD, FOG etc) discharged by red meat processing.

Generated and captured methane, sludge production and assay, non-energy emissions (ammonia, carbo dioxide consumed in process, refrigerants, acetylene and other welding gases, ethylene glycol), and whether plants have a greenhouse gas or carbon neutrality target separate to the general MLA CN30 target.

4.4 Solid Waste and Local Amenity

Production of recyclable and non-recyclable wastes including carcasses, hides, cardboard/paper, pond crust and sludge, paunch, manure, rubber, ash, plastic, scrap metal, oil, and general waste. Processors were asked to assign waste streams to either landfill, compost/recycling, or other management methods. Local amenity issues including odour and noise complaints from residential, commercial, industrial or rural sources.

4.2 Key Environmental Performance Indicators – Outputs

Table 1: Types of environmental performance indicators

Resource Use Efficiency	These are quantitative indicators that describe the technical efficiency of operations, e.g. energy use efficiency, water use efficiency, waste production. The performance result is largely within the sphere of control of the business depending on technology adoption and operating practices. The major issue is that the importance of achieving a high level of efficiency may vary from one location to another, e.g. locations may differ in terms of local water stress and is likely to be limited by scale i.e. larger plants have greater capacity to take advantage of economies of scale when implementing projects.
Environmental Impact	These are quantitative indicators that describe potential environmental impact: For example, global warming potential associated with energy and non-energy based GHG emissions. These indicators more closely reflect actual concern (i.e. environmental performance), but may be impacted by factors outside the direct control of the business (e.g. emissions intensity of grid electricity).
Practices / targets	These indicators describe rate of adoption of good environmental management practices. The advantage is that these indicators describe concrete actions. However, their link to actual environmental impacts may be weak.

Table 2: Environmental performance indicators

Environmental Performance Indicator	Description	Key Indicator
Water use	Red meat processing facilities critically depend on water for their operation. As with all industrial facilities, there is a need to use water more efficiently, especially in regions where water scarcity is high. Water recycling can be used to reduce water demand, subject to food safety and other regulations. Water is primarily consumed in washdown of bellies, yards, boning and slicing floors, slaughter floor, hides and offal processing, rendering, and hand washing and sterilization.	Water consumption kL / t HSCW Demand met by recycling water %

Waste water emissions	Red meat processing facilities can generate wastewater streams rich in nutrients and organic matter. Good operating practices can limit wastewater contamination and treatment can be used to limit harmful and costly (if discharged as trade waste) emissions to the environment.	Untreated quality P, N, BOD, FOG mg/L Emissions to environment P and N mg/L
Energy use	Red meat processing facilities can be important energy users, associated particularly with refrigeration, production of steam and hot water, and rendering. Energy consumption is associated with a range of environmental impacts and is an important cost of production.	Electrical kWh / t HSCW Thermal GJ / t HSCW
Greenhouse gas emissions	Reducing greenhouse gas emissions is a major global challenge. Red meat processing facilities can play an important role in limiting direct emissions (Scope 1) as well as emissions associated with the use of electricity on site (Scope 2). Red meat processors have less agency over indirect (Scope 3) emissions and these are currently not included. Processors should be aware of their Scope 3 emissions, with the most relevant examples being transporting and distribution of product in trucks / ships not owned by the processing company, business travel and commuting, and leased assets.	GHG t CO_2 equivalent / t HSCW (Scope 1 and 2)
Waste to landfill	Red meat processing facilities can generate large quantities	Waste to landfill t / t HSCW

	of organic wastes which have the potential to be beneficially recycled into new products. In addition, the production of other miscellaneous solid waste can be limited to reduce demand for new materials and the environmental impacts associated with solid waste disposal (i.e. via landfilling).	Recycling fraction %
Local amenity	Red meat processing facilities have the potential to emit odours and noise which can impact the amenity of the surrounding community.	Odour complaints (number/site/year) Noise complaints (number/site/year) Source of complaints (residential, commercial, industrial, rural)

4.3 Note on outputs

It should be noted that water use efficiency (kL / t HSCW) is likely to differ between plants processing large and small species, with plants processing small species generally having a higher specific water consumption kL / t HSCW. Water use is thus reported on an industry wide basis along with breaking down further to large species only and small / mixed species plants.

Also, while most plants that reported operating a rendering plant, some did not. As rendering is a very high energy consuming process, this can have significant effect on the thermal and electrical energy consumption per t HSCW. A further complexity is that many larger sites may take hides, offal, or renderable material from smaller plants owned by the same company. Thermal energy demand is reported on an industry wide basis along with separating to rendering and non-rendering plants.

4.4 Sample Size

In total, responses were obtained from 26 sites, with complete data sets received for 25 of those. This is a significant improvement in the sample size from the 2015 EPR, where 14 responses were received (also 14 in 2010), ten in 2003, and 9 in 1998. This is an encouraging result, showing that sites may be taking a greater interest in sustainability and considering the allocation of more resources to achieving emissions and energy intensity.

The sample is not representative of the entire industry however, as the responses were skewed towards medium and large scale facilities. Of the approximately 150 red meat processing facilities operating in Australia over all scales and species, the 26 responses represent 17.3% of total businesses, but 41.3% of the 3,464,022 t HSCW for all red meat production reported from July 2019 to June 2020 by ABS series 7218013

Table 3: 2020 EPR plant respondents

Parameter	Range
Production	6,460 – 181,392 t HSCW pa
Animal mix	Cattle only – 15 Lamb / sheep only – 5 Mixed species[1] – 6
Location	QLD - 8 NSW - 6 ACT - 0 VIC - 3 TAS - 2 SA - 3 WA - 4 NT - 0
Local water stress	<0.1 to 0.8-0.9
Operations	Rendering - 21 Boning - 17 Hides - 9 Offal - 17 Trucking - 11

[1] Inclusive of cattle, veal, lamb, sheep, goat, venison, or pork

5.0 PROJECT OUTCOMES

5.1 Water Use

Especially in regions with a high local water stress, reducing the water intake and fraction of water demand met by recycling is a common goal along the Australian red meat processing industry. This performance indicator calculated water intake at 7.92 kL / t HSCW for the whole industry, and 8.16 kL / t HSCW and 7.84 kL / t HSCW for small and mixed species plants and large species only plants respectively.

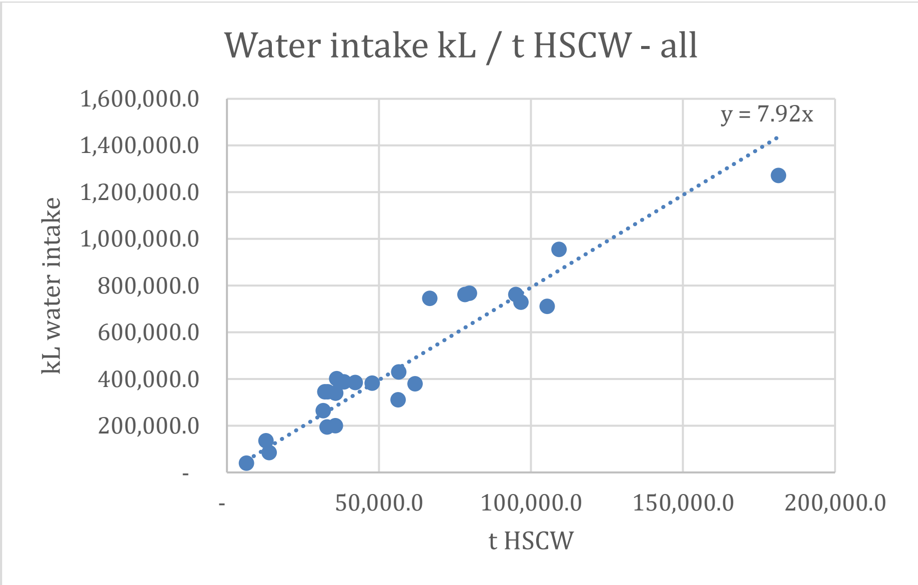


Figure 1: Water intake kL / t HSCW - all plants

Water intake varied on a per site basis from 5.5 to 11.2 kL / t HSCW, with 11% of the demand met by recycled water on average. This is a slight decrease from the 2015 EPR, where 13% of demand was met by recycling, however this is likely due to a significantly larger sample size and range this year – 25 vs 14 sites and 6,460 – 181,392 vs 16,288 – 220,353 t HSCW pa.

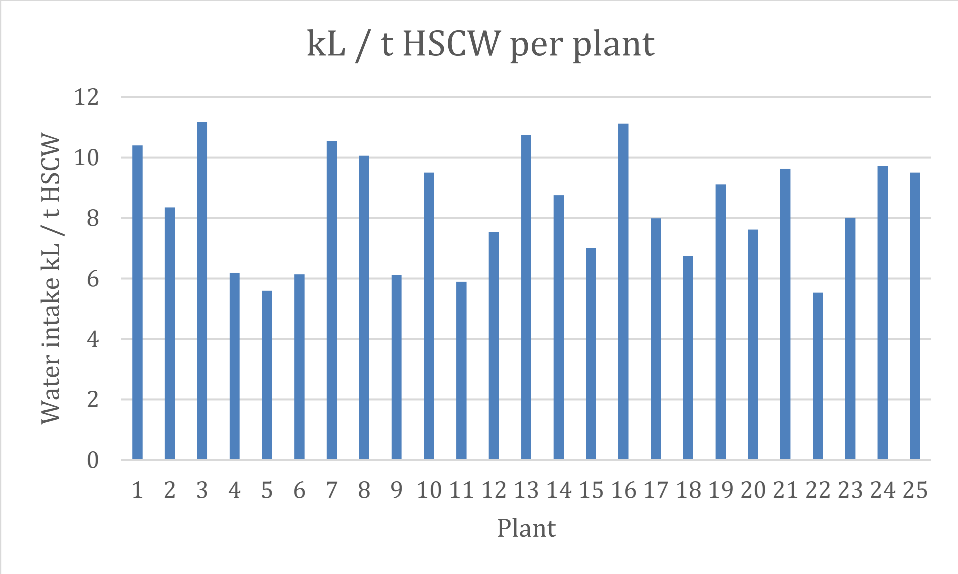


Figure 2: Water intake kL / t HSCW per plant

Comparing to the last EPR in 2015, where a result of 8.6 kL / t HSCW was reported, this shows a reduction of water use intensity of 7.9% or 0.7 kL / t HSCW. Considering the 2008/2009 FY EPR where 8.7 kL / t HSCW was reported, this shows that the Australian red meat processing industry is continuing to achieve reductions in water intake. This is a very positive step for the industry and will greatly improve the industry's social license to operate.

On average, town water was 70% of demand, next highest was bore water at 25%, and lastly water intake from a water body was 6%. There was no reported intake from dams or rainwater. 60% of sites reported having a water efficiency target, with 40% either reporting no or not specifying. There was no statistically significant difference in water use intensity between sites with and without a water efficiency target. 28% of sites reported detailed water submetering, with 72% either reporting no or not responding to this question. There was no statistically significant difference in water use intensity between sites with and without submetering.

Water use reduction initiatives were not recorded in this EPR; those reported in 2015 included

- Annual water use efficiency improvement targets
- Weekly benchmarking of site water use efficiency
- Reuse of sterilizer water
- Participation in State government water use efficiency programs
- Wastewater treatment plant under redevelopment to produce potable water
- Installed sensors on washers
- Installed additional water meters to better understand water flows
- Installed timers at hand washing stations
- Water efficient jets on cleaning equipment
- Collection of rain water
- Use of recycled water for lawns, washing cattle, cleaning yards and screens

5.2 Wastewater

Red meat processors generate various wastewater streams that may be rich in nutrients and organic matter, and managed along a spectrum of irrigation to fields, raw discharge, and treated discharge. While wastewater treatment consumes energy and is a source of greenhouse gas emissions, this indicator reports only wastewater volume and the composition of nutrients and organic load.

The average site wastewater discharge volume calculated was 6.5 kL / t HSCW, a significant improvement of 2 kL / t HSCW on the 2015 figure of 8.5 kL / t HSCW, or 23.5%. Relative to the intake, this survey calculated 83% of water intake being discharged, compared to 99% in 2015.

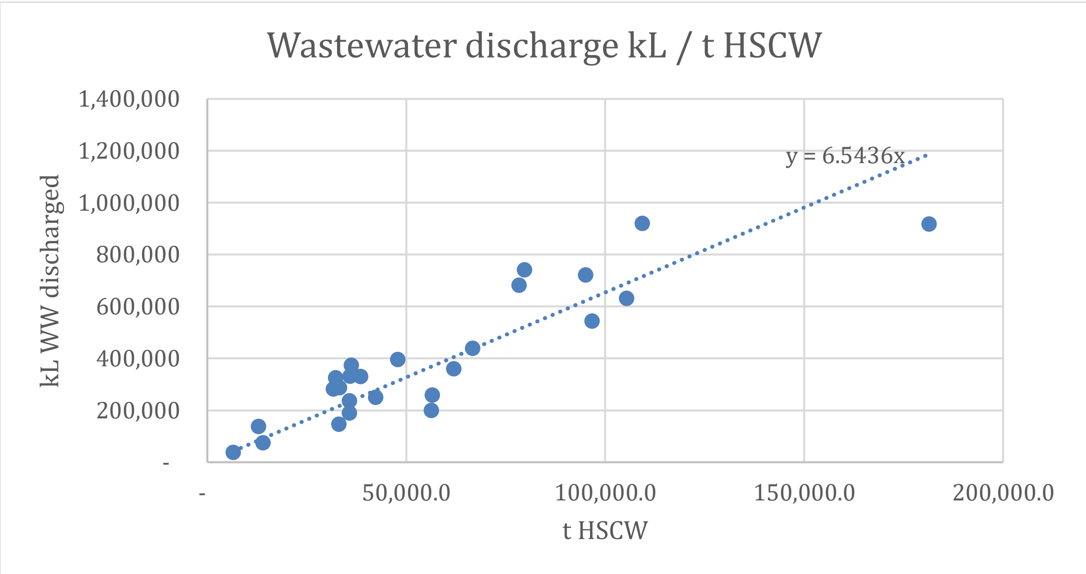


Figure 3: Wastewater discharge kL / t HSCW - all plants

Comparing the below figure with figure 2, shows that there is not a strong correlation between water intake and wastewater discharged.

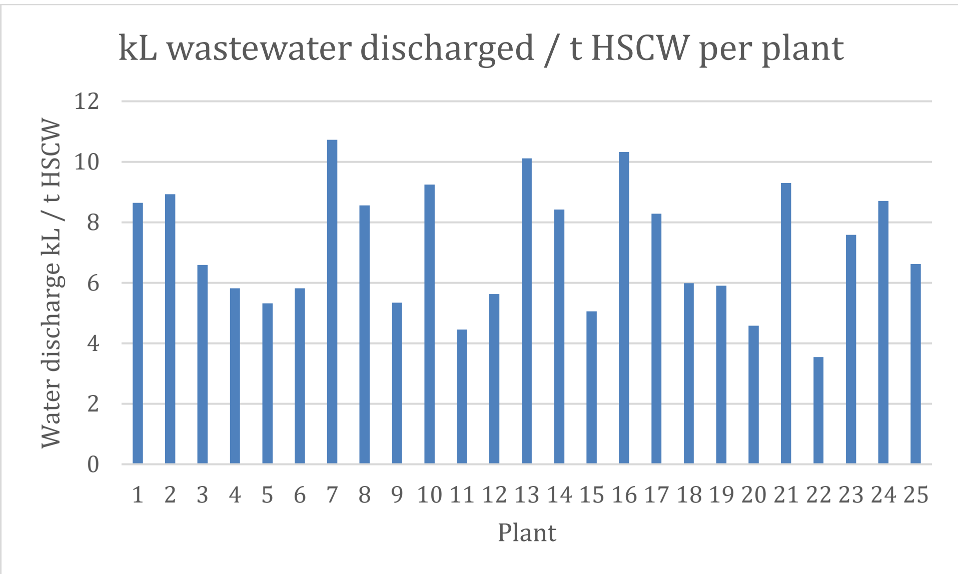


Figure 4: Wastewater kL discharged / t HSCW per plant

The average untreated wastewater profile calculated and compared to 2015 was

Table 4: Untreated wastewater profiles

	2020	2015	Reduction
Phosphorous (P) mg/L	30.4	33	7.9%
Nitrogen (N) mg/L	174.5	250	30.2%
Biological Oxygen Demand (BOD) mg/L	2,257.2	2,657	15.0%
Fats, Oils, Greases (FOG) mg/L	1,143.3	1,780	35.8%

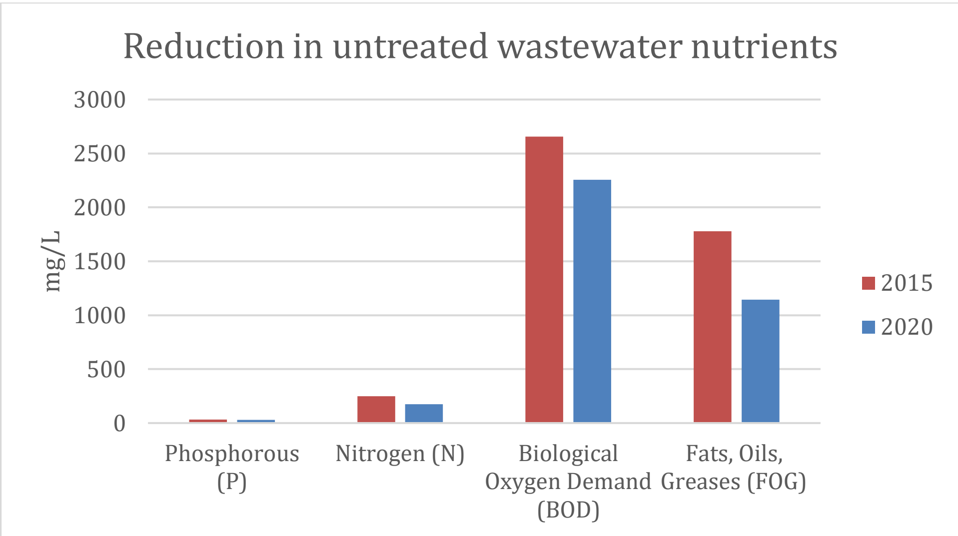


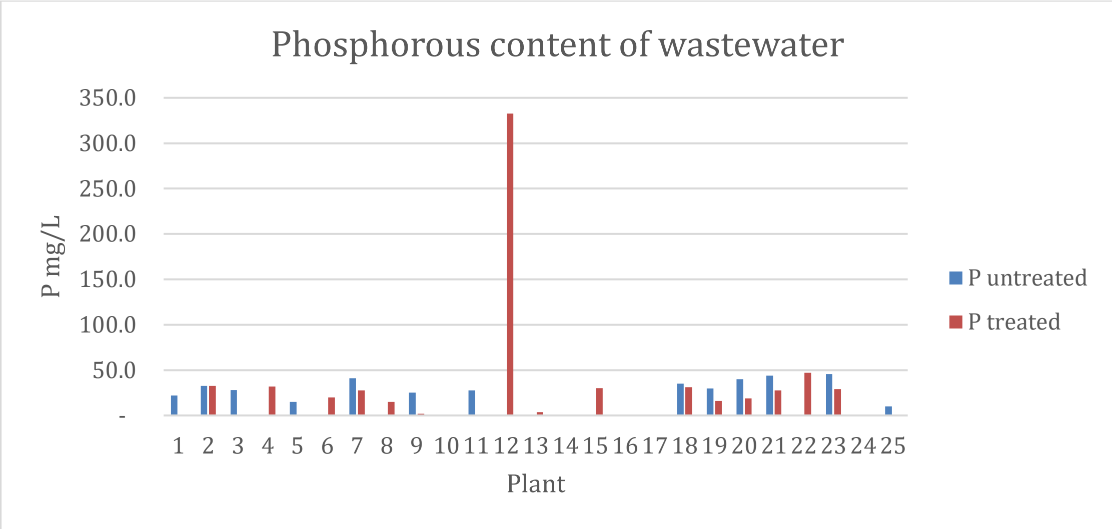
Figure 5: Comparison of untreated wastewater nutrient content, showing reduction from 2015 to 2020

The above table and figure show significant reduction in nutrients and organic load being discharged in wastewater. Twenty percent of sites (5) discharged at least a portion of their wastewater untreated, for 3% to sewer and 4.5% to irrigation, a regression from the 2015 survey where no sites discharged untreated wastewater to environment and estimated > 99.9% undergoing some treatment and 0.1% discharged untreated to sewer.

Table 5: Treated wastewater profiles

	2020	2015	Reduction
Phosphorous (P) mg/L	44.3	28	-58%
Nitrogen (N) mg/L	99.4	47	-111%

Of the 25 sites, 7 discharged treated wastewater to sewer, 11 to irrigation, and 1 to council wetlands. The average nutrient content of treated wastewater was 44.3 mg/L Phosphorous and 99.4 mg/L Nitrogen, a considerable regression compared to 2015 in P (28 mg/L) and an increase in N (47 mg/L).



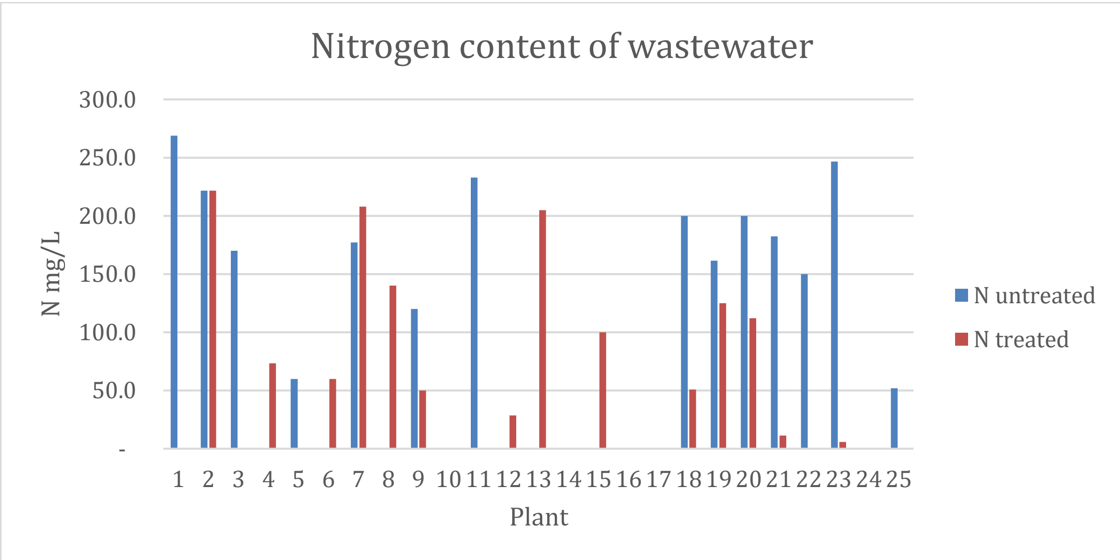


Figure 6: Nutrient content of untreated (top) and treated (bottom) wastewater

5.3 Energy Use

This indicator measures the performance in energy use efficiency, with energy consumed principally as thermal energy in boiler plants for rendering and as electricity for refrigeration. Energy is a significant cost of production, second only to labour and is associated with a range of environmental impacts.

It should be noted that in the 2015 EPR site energy use was reported as 3005 MJ / t HSCW, as the sum of two components – the average value for red meat processing without rendering and just the rendering process. If energy use associated with rendering was excluded, the average was reported at 1,461 MJ / t HSCW.

Table 6: 2015 EPR breakdown of energy sources

Energy source	% of total	Equivalent use intensity MJ / t HSCW
Electricity	35.6	1069.8
Natural gas	30.2	907.5
Coal	18.3	549.9
Fuel oil	1.4	42.1
LPG	0.6	18.0
Unleaded petrol	0.3	9.0
Diesel	0.4	12.0
Biomass	6.7	201.3
Biogas	6.6	198.3

The energy use intensity calculated in this survey was 3316.2 MJ / t HSCW, or a total increase of 10.4% compared to the 2015 value. The energy value associated with rendering was 1,223 MJ / t HSCW, meaning that for this sample size and excluding rendering the energy use intensity is 2092.9 MJ / t HSCW, or a 43% increase on the 2015 figure.

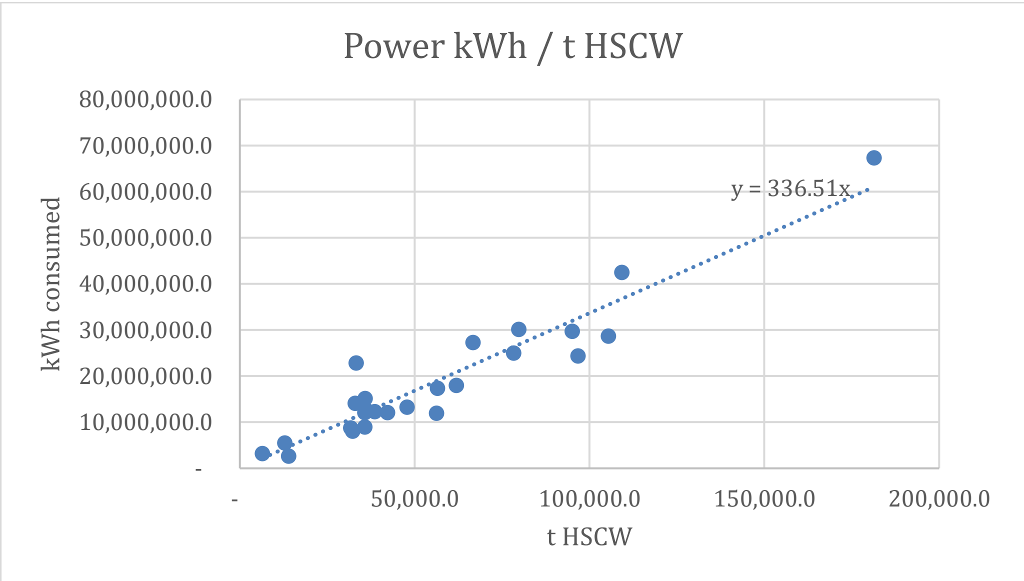


Figure 7: Electricity kWh consumed 336.51 kWh / t HSCW

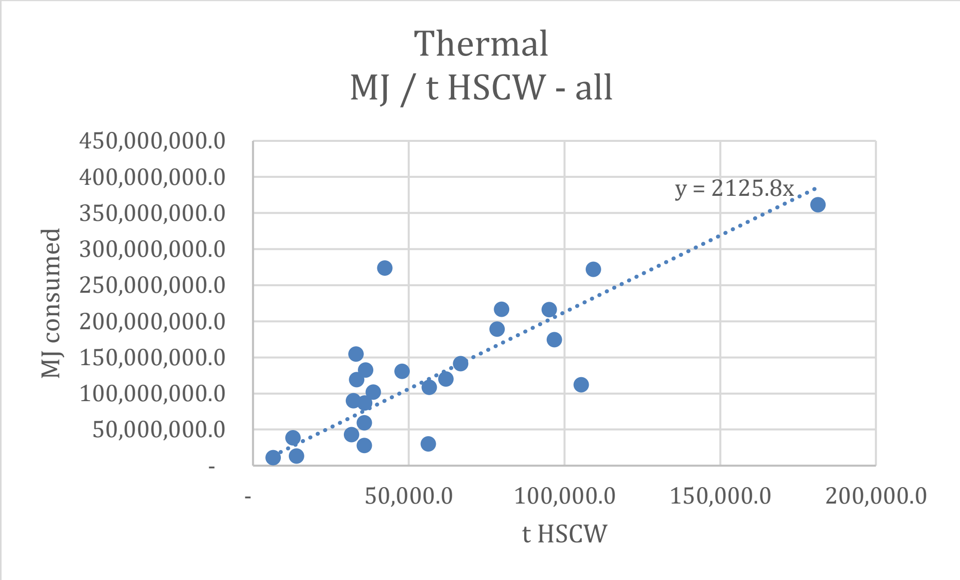


Figure 8: Thermal energy consumed MJ / t HSCW – inclusive of liquid fuels for transport. 2125.8 MJ / t HSCW

Table 7: 2020 EPR breakdown of energy sources[2]

Energy source	% of total	Equivalent use intensity MJ / t HSCW	% change compared to 2015
Electricity	34.6	1141.7	+6.7
Natural gas	30.3	1046.0	+15.3
Coal	19.5	670.7	+22.0
Fuel oil	2.6	89.8	+113.4
LPG	1.6	56.5	+213.3
Unleaded petrol	0.04	1.5	-83.1
Diesel	1.8	62.5	+419.7
Biomass	3.6	124.4	-38.2
Biogas	5.8	200.0	+0.9
Butane	0.0001	0.004	

As with the 2015 EPR, electricity remains the largest source of energy intensity, followed by natural gas, then coal, with the smaller contributing loads in fuel oil, LPG, liquid fuels, biomass, and biogas.

[2] Note that to avoid double counting energy in this table, energy is counted as its final end use, that is, for example if natural gas is sent to a generator to produce electricity, the energy consumed here is reported as electricity kWh not natural gas MJ

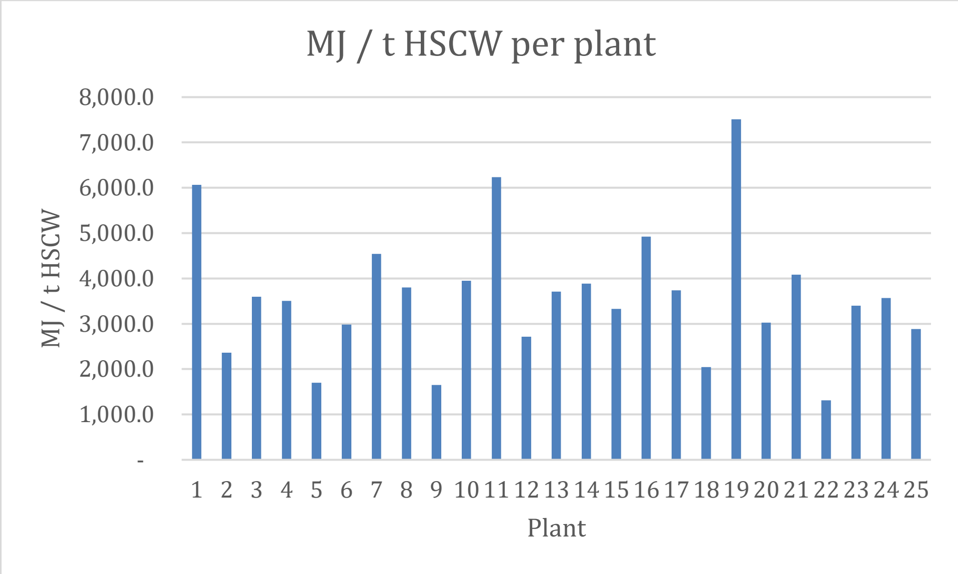


Figure 9: MJ / t HSCW per plant

The figure above shows that the total industry wide figure of energy intensity is skewed by a small number of plants, which is a result of the significantly larger sample size in this EPR compared to 2015. Another likely contributing factor in this high variability is the variability in sites running their own trucking fleet and thus consuming significantly larger amounts of energy dense liquid fuels.

36% of sites reported having a formal energy efficiency target, with 24% reporting no energy efficiency target, and the remainder not answering this question. With such a small response rate to this question, it is not appropriate to make inferences on whether sites with an energy target perform better relative to sites without such a target, as shown in the below figure with sites that have a formal energy efficiency target highlighted in red. While the previous EPR concluded the importance of target setting in environmental performance improvement, this conclusion cannot be made based on this data.

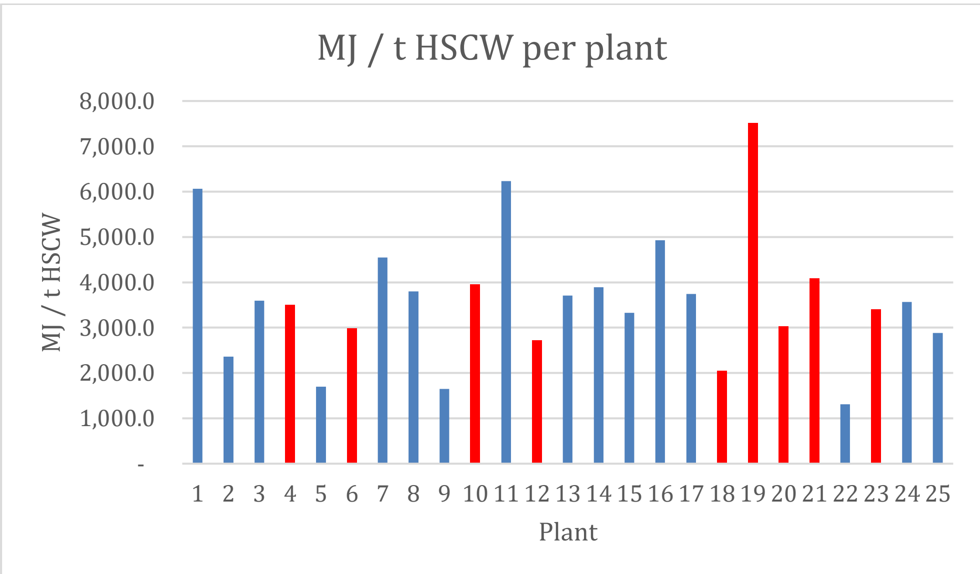


Figure 10: MJ / t HSCW per plant - showing non-correlation between sites with energy efficiency target and lower energy intensity

The processing industry should continue to pursue energy use efficiency initiatives, including but not limited to:

- Biogas capture and utilization as boiler fuel or power generation
- Greater thermal and electrical energy monitoring with efficiency targets
- Greater allocation of resources towards achieving targets
- Waste to energy
- Biomass boilers
- Benchmarking of energy intensity between sites. This has been achieved primarily with the use of the Energetics energy benchmarking tool
- Participation in state and federal government energy programs
- Energy audits by 3rd party consultants to help identify opportunities
- Variable speed drives on refrigeration plant
- Hydrogen for vehicle fuel
- Voltage optimization
- Power factor correction
- Boiler efficiency – oxygen trim, air and water preheating, blowdown setpoints

5.4 Greenhouse Gas Emissions

These indicators report the industry's performance in reducing the intensity of greenhouse gas (GHG) emissions from red meat processing. The industry has a shared goal of achieving CN30 or carbon neutrality by 2030, which will greatly improve the environmental sustainability and social license to operate and require a multi-faceted approach including fuel switching, energy intensity reduction, sequestration, offsets, genetics, and nutrition. It has been reported that the contribution of processing emissions in the total product life cycle of red meat is relatively small at 1 to 5%.

Emissions intensity in this EPR is separated into energy and non-energy based, including emissions from grid power and fuels burned on site, and emissions from wastewater respectively.

Emissions can be broadly classified as one of three scopes

- Scope 1 emissions encompass direct emissions from business activities or sources owned or controlled by the processor. Examples include burning fuel in a boiler and diesel for trucking
- Scope 2 emissions are indirect emissions generated by purchased electricity, steam, heating, and cooling that are transferred to the retailer. Examples include emissions from grid power or a third party cold chain operator
- Scope 3 emissions include all other indirect emissions upstream and downstream of the processor in the value chain, examples include purchased goods and services, waste, and business travel and employee commuting.

On average, total site GHG emissions were 397 kg CO_2-e / t HSCW, an 8.1% reduction compared to the 2015 value of 432 kg CO_2-e / t HSCW.

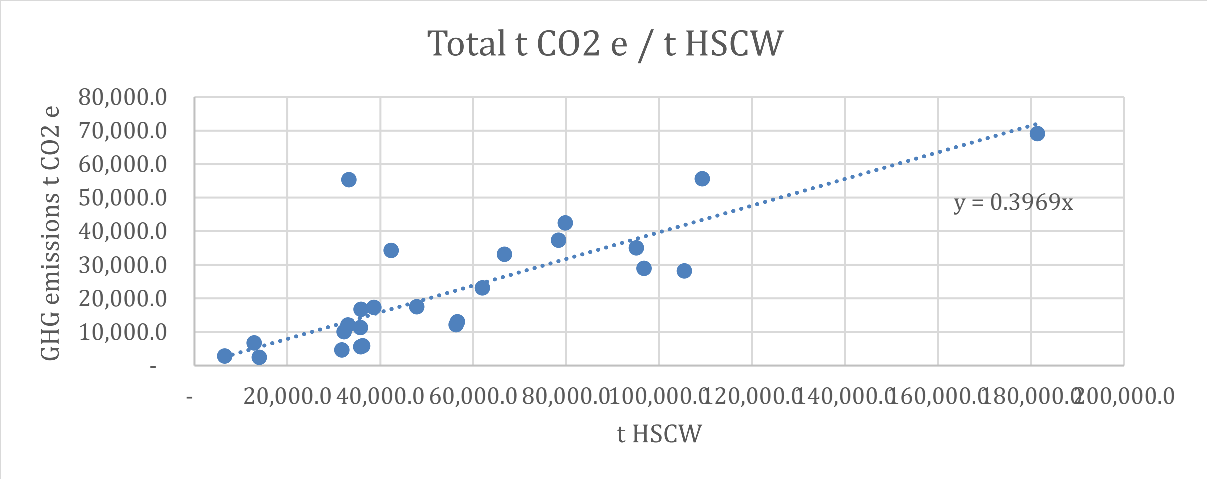


Figure 11: Total site emissions 397 kg CO2 e / t HSCW

Table 8: Breakdown of emissions sources by energy source

Energy source	% of total	Scope
Electricity	59.7	2
Natural gas - thermal	13.3	1
Natural gas - power	0.8	1
Coal	14.9	1
Fuel oil	1.7	1
LPG - thermal	0.7	1
LPG - transport	0.1	1
Unleaded petrol	0.03	1
Diesel – power	2.1	1
Diesel - transport	4.3	1
Biomass	0.04	1
Biogas - thermal	0.2	1
Biogas - power	0.01	1
Wastewater	2.2	1

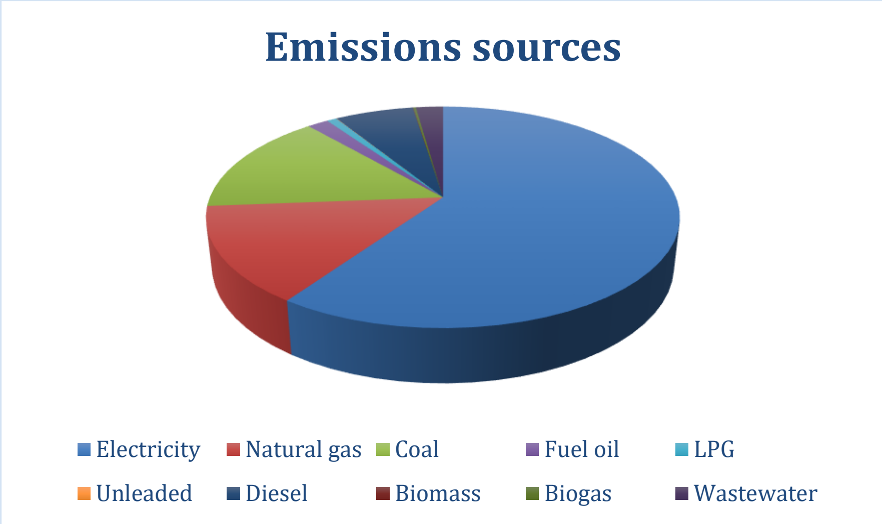


Figure 12: Breakdown of emissions sources by energy source

5.4.1 Energy Based

Energy based emissions include emissions from the purchase of grid electricity (Scope 2) along with emissions from combustion of coal, natural gas, biogas, liquid fuel, LPG, and fuel oil (Scope 1). The total figure for energy based emissions is 386 kg CO_2-e / t HSCW, on average made up of 60% Scope 2 and 40% Scope 1 emissions. This is consistent with the 2015 allocation where Scope 1 emissions made up 44% of the total and 56% remainder made up by Scope 2. Neither surveys recorded Scope 3 indirect emissions.

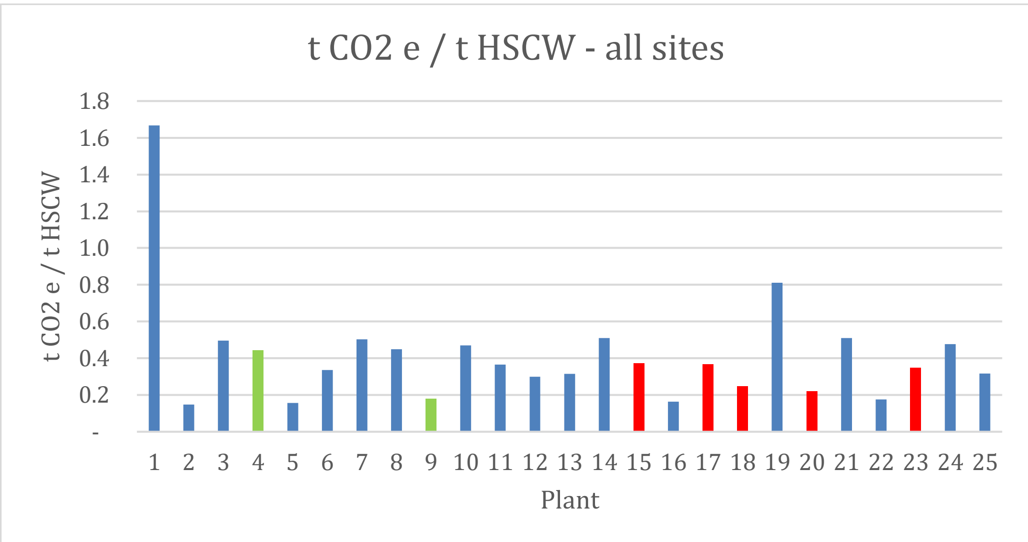


Figure 13: Specific energy based emissions per plant

The figure above shows the specific energy based emissions for all sites, with sites that reported having a formal emissions reduction target highlighted in red. It can be observed that two of the respondent sites in particular are far beyond the mean, with the remainder of sites producing emissions within a mean range of approximately 300 kg CO_2-e / t HSCW. Sites without a rendering plant are highlighted in green, showing no significant difference in specific emissions production due to rendering. This observation runs counter to the 2015 EPR, where it was calculated that rendering contributes an additional 36% to site emissions (432 vs 318 kg CO_2-e / t HSCW for non-rendering).

In order to achieve the industry goal of decarbonizing completely by 2030, the processing sector should further investigate the following low or no emissions energy sources and efficiency upgrades

- Biogas capture from organic digestion and utilization as boiler fuel or power generation
- Waste to energy (e.g. paunch and waste wood fired boiler)
- Biomass (e.g. woodchip) boilers
- PV solar
- Concentrated solar thermal
- Hydrogen for vehicle fuel
- Hybrid power systems: biogas cogen, PV, energy storage (e.g. batteries, thermal storage, compressed air turbines)
- Boiler efficiency – oxygen trim, air and water preheating, economisers, blowdown setpoints

5.4.2 Non-Energy Based Emissions

Non-energy-based emissions are calculated as the difference between generated methane in the wastewater treatment plant and methane that is utilized in a boiler or engine, with the remainder being captured (flared). This section of the EPR was quite sparsely responded as not all sites generate methane from their wastewater. Many sites did not report their consumption of refrigerants.

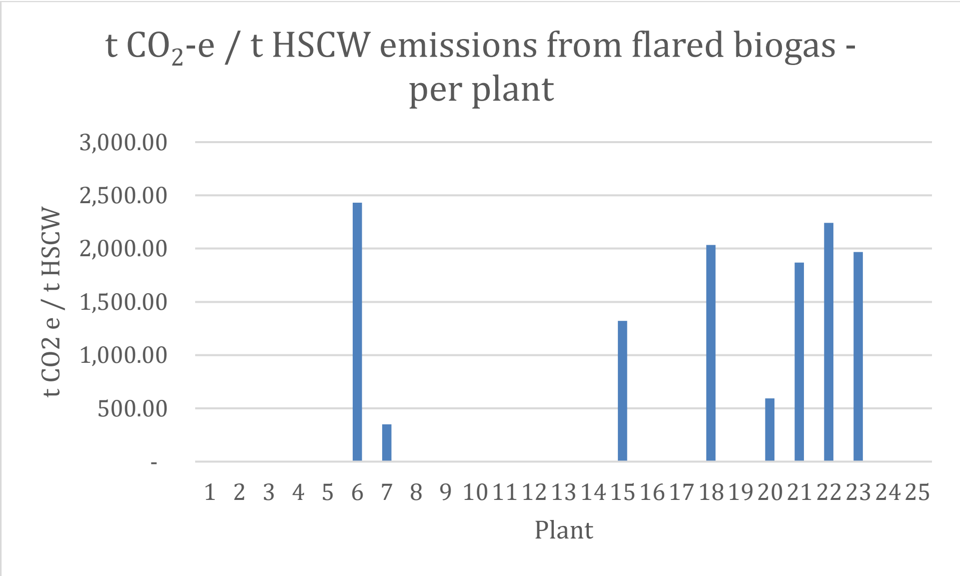


Figure 14: Emissions from flared biogas

5.5 Waste to Landfill

This indicator measures the performance of the processing sector in minimizing the tonnage of recyclable and non-recyclable wastes sent to landfill. Since the last EPR in 2015, there have been significant increases in the state landfilling levies, meaning that this is becoming less of an option for disposing of red meat processing wastes, and sites should look towards recycling, value-adding, or recovering energy and nutrients from their waste streams. Waste sent to landfill is a very visible aspect of an industry's environmental impact and has direct implications social license to operate.

Assessments of waste produced by red meat processing has shown that the primary tonnages are organic and mostly comprised of paunch solids, manure and yard wastes, along with sludge and pond crusts from wastewater treatment. Other organic wastes include carcasses (if not rendered), hides (if not tanned), and cardboard/paper. Organic wastes produced by red meat processing tend to be recycled where possible (i.e. not contaminated).

Inorganic wastes include rubber, ash, plastic, waste salt, scrap metal along with batteries, oil and general waste. With the exception of uncontaminated plastic, scrap metal, and oil, these wastes tend to be landfilled.

The average figure for waste sent to landfill in this EPR was 11.9 kg / t HSCW, a very large increase of 102% compared to the 2015 value of 5.9 kg / t HSCW.

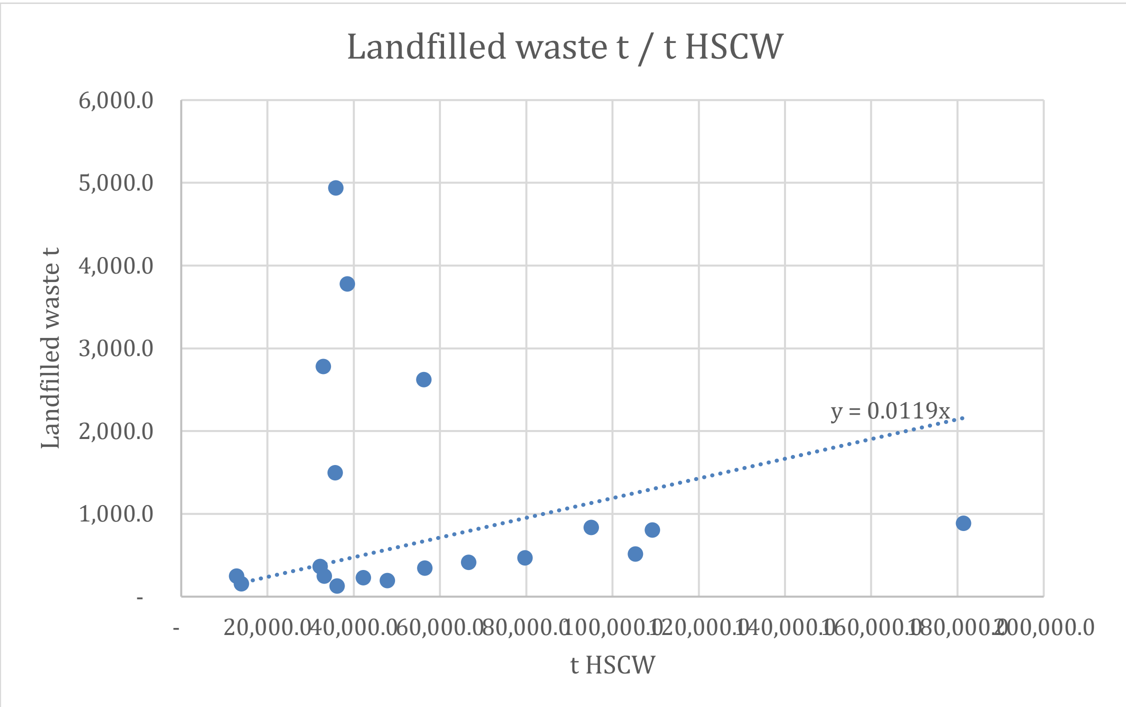


Figure 15: Total landfilled waste 15.5 kg / t HSCW

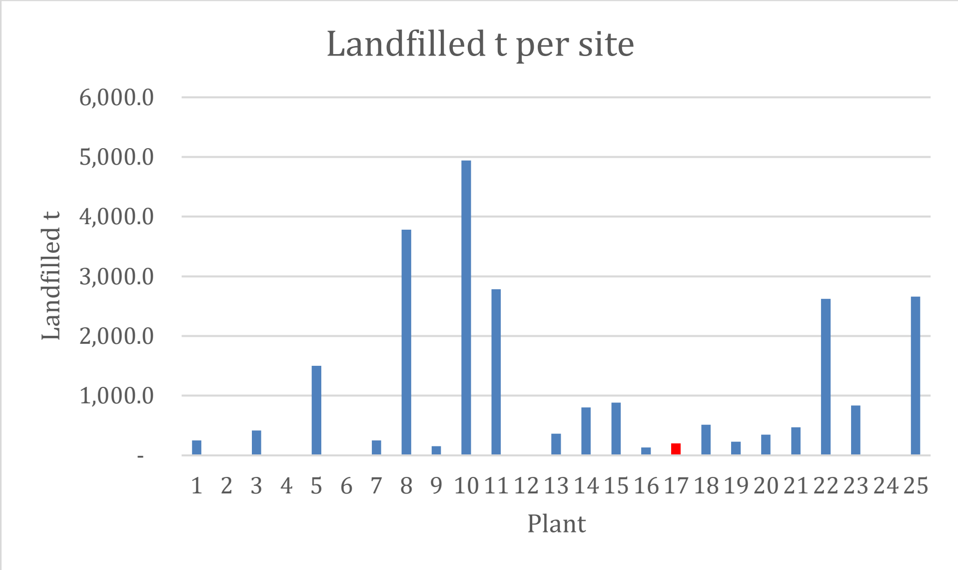


Figure 16: Individual tonnages sent to landfill t by site, plant 17 highlighted in red was the only respondent with a formal waste reduction target

Only one site reported having a formal waste reduction target, all others either reported no target or did not answer this question. With such a low response rate to this specific question, there is some evidence that lack of specific solid waste goals or targets can lead to increased tonnages of material being sent to landfill. It can also be observed in the above figure that there are certain sites that are drastically over-producing landfilled waste per business metric compared to the rest of the sample.

Sites should continue to reduce landfill tonnages by:

- Composting of organics (on or off-site)
- Adopting a formal site waste reduction target and KPI
- Packaging improvements: reduced material, use of recyclable or bio-plastics
- Dewatering
- Segregating materials for recycling (e.g. plastics and paper/cardboard)
- Process redesign to reduce waste production

5.6 Local Amenity

This indicator measures performance in reducing complaints about red meat processing sites production of odour and noise and indicates the relationship of the meat processing sector with the wider society and social license to operate.

An issue that has been identified by processors is urban encroachment by residential development in previously uninhabited areas, increasing the likelihood of complaints by bringing neighbours into closer proximity. For these sites, odour and noise abatement is a more significant issue.

5.6.1 Noise

Noise complaints were reported to be comparatively rare, at far below 1 per site per year. Of the 25 sites, only one reported receiving two noise complaints from a residential source, attributed one each to a refrigeration fan and cattle. The remainder of respondents reported no noise complaints. This continues the positive trend observed in the 2015 EPR of receiving very few noise complaints.

5.6.2 Odour

Odour complaints are relatively more common than noise complaints, with on average 3.8 per site per year reported. This is a strong 46% improvement compared to 2015, where 7.1 odour complaints per site per year were recorded, showing that the processing sector is making good progress in reducing odour amenity.

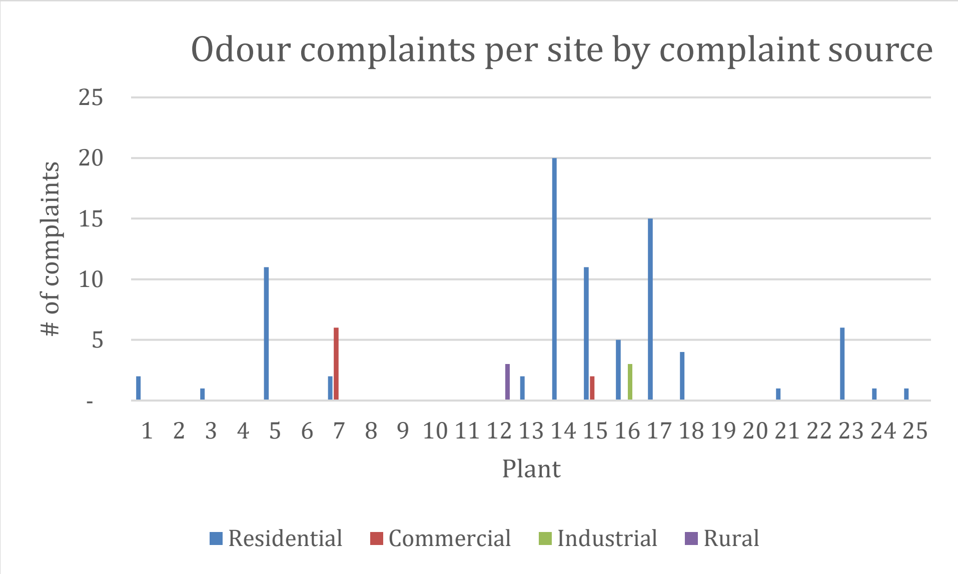


Figure 17: Odour complaints per plant

As seen in the above figure, 56% of sites reported receiving at least one complaint, with a select few sites receiving far more than the rest. The vast majority of complaints are received from residential sources, with the next highest source from commercial sector.

Of the odour complaints received, the most common sources were:

- Rendering
- Wastewater treatment
- Animal urine/faeces
- Cattle trucks

While the industry has made strong progress in reducing odour amenity, initiatives to further improve this indicator may include:

- Covering anaerobic lagoons and ponds where currently uncovered. This will also reduce fugitive methane emission intensity
- Upgrading or installing biofilters in the rendering plant
- Improved operating protocols or scheduling in the rendering plant
- Improved odour monitoring
- Intensified composting to reduce odorous wastes sitting in open air

6.0 DISCUSSION

This discussion explores the hypothesized sources of observed variations in environmental performance between 2020 and 2015.

6.1 Water Use and Wastewater

The finding that water use intensity varied between small and large species processing plants is consistent with the typical industry observation that a greater specific water consumption is required to process small animals (e.g. lamb, sheep, goats, and pigs) compared to cattle, with a hypothesized reason for this being due to water consumption at a plant having a fixed and variable component, meaning that there is a baseline demand for water (e.g. boning room cleaning, hand washing, sterilization) that is independent of throughput, with the variable component of yard wash, belly wash, slaughter floor washdown being dependent on throughput. The 2015 environmental performance review suggested that in some cases, water demand is on a per head basis with small animals yielding smaller carcasses.

The observed reduction in water discharged as a fraction of intake suggests significant improvements in in-plant water usage e.g. for irrigation, cropping and re-use, however it should be noted that these are not the only contributing factors, as there may be larger volumes of runoff, additions to wastewater system from rainwater, or evaporative losses not being recorded.

The reduction in untreated wastewater nutrient load is hypothesized to be due to strong improvements in wastewater management practices towards conserving water for cleaning where possible and segregating high nutrient solid loads (e.g. blood, paunch, and fat) from wastewater streams, instead directing these to rendering or other value adding. Treated wastewater nutrient loads were seen to have increased in the 2020 survey compared to 2015; this may be due to reduced water intake volumes increasing the concentration of nutrients along with greater acceptance thresholds for trade waste; however a more likely explanation is mismeasurement and misreporting by sites as more than one site reported either only untreated or treated composition or neither, or treated individual waste nutrient profiles higher than untreated, suggesting either significant evaporative losses or ineffectual unit operations in the wastewater treatment plant. Only 56% of respondents had composition data on their untreated or treated wastewater; thus making inferences on the industry performance from this reduced sample size may be tenuous.

6.2 Energy Use

The calculated figure for energy use intensity and observed increase compared to 2015 should be considered in the context of energy performance and the complex nature of managing resource efficiencies in red meat processing over time, where 2013/2014 (2015 EPR) was significantly lower than 2008/2009, which was a marked increase of around 600 MJ / t HSCW compared to 1998 and 2003 EPRs. The most likely explanation for the large increases in fuel oil, LPG, and diesel consumption is not due to a significant increase in actual consumption, rather a larger amount of reported use in this EPR compared to the last. That is, for example, this survey had two respondent sites running fuel oil boilers, whereas it is likely that there were none in the last EPR.

It is expected that over time there is a trend towards processors adopting more energy intensive operations on site rather than subcontracting to third parties in contrast to earlier business models. Processors have been observed incorporating value adding and retail-ready production lines to their traditional business model, engaging in more on-site chilling and freezing rather than subcontracting to a third party cold chain operator, and increasing other operations such as composting and cropping for fodder or nutrient fixing. As an example, MLA has recently identified in various reports that there is interest in chilling and freezing domestic and export-bound carcasses to a lower temperature (and thus more energy intensive process) to increase shelf life.

In summary, the increase in energy intensity observed in this EPR compared to 2015 is hypothesized to be due to a combination of factors

a) Wider sample size, increasing chance for outliers to skew average – see figure 6
b) Greater diversity and comprehensiveness in reporting of energy sources, particularly in fuel oil, diesel, LPG, and unleaded petrol
c) Historical context, while higher than the 2013/2014 energy intensity, this year's energy intensity is lower than that in 1998, 2003, and 2009
d) Significantly greater proportion of respondents processing either only small species or mixed. 11 respondents out of 25 in this EPR vs 3 out of 15 in 2015
e) the complex nature of managing resource and asset efficiencies in red meat processing, and the nexus between energy use, water treatment & waste recycling.

6.3 Greenhouse Gas Emissions

The assumed reason for an observed increase in energy intensity along with a decrease in emissions intensity is due to the dominant contributor of Scope 2 emissions from grid power (60% of total). As greater amounts of utility scale renewables come online in the national power grid and old high emissions generators (e.g. Hazelwood) are decommissioned, the grid power carbon intensity has reduced accordingly, meaning that for an equivalent volume of power consumed from the grid, fewer Scope 2 emissions are attributed to the processor. Processors now pay for more renewable grid power via large and small scale generation certificates in their power bill. Compared to the 2015 EPR, this survey had a far greater proportion of respondent sites from states where a significant decrease in emissions factor intensity is observed.

Table 9: State based grid power scope 2 emissions factors

State	2020 Emission Factor kg CO_2-e / kWh	2015 Emission Factor kg CO_2-e / kWh	Reduction in Emission Factor Intensity
NSW / ACT	0.81	0.84	3.7%
VIC	0.98	1.13	15.3%
QLD	0.81	0.79	-2.5%
SA	0.43	0.56	30.2%
WA (SWIS)	0.68	0.76	11.8%
NT	0.62	0.67	8.1%
TAS	0.17	0.12	-29.4%

It is difficult to attribute the observed emissions intensity reduction to actual initiatives from the industry due to the following contradictory factors:

a) Observed increase in energy use intensity
b) No significant increase in energy use intensity of solar, biomass, or biogas
c) No observed reduction in grid power or thermal fuel consumption, and
d) Wider sample size capturing more sites in states where Scope 2 intensity (Table 9 above) has decreased independently of processor action

6.4 Waste to Landfill

A possible difference in the calculated landfill tonnage in the 2020 EPR vs the 2015 EPR is that it was reported that the following wastes are sent to landfill by at least one site:

- No commercial value (NCV) skins
- Paunch solids
- Rubber
- Plastic
- Waste salt
- Batteries
- Oil
- Fluorescent tubes
- General waste
- Pallets
- General waste

Whereas the 2015 figure was calculated for only solid waste sent to landfill. Sites did not break down the components of their general waste, however large volumes of liquids (e.g. waste oil, non-renderable blood, un-dewatered paunch) sent to landfill under the classification of “general waste” may skew these results.

It is also expected that there was a significant increase in waste production due to COVID conditions, where most processors informally reported little to no changes to production schedule, meaning that changes to business as usual and increased demand for PPE and disposables, including masks, gloves, wipes, hairnets, disposable gowns and sanitiser has resulted in more solid waste generation with limited disposal options for these regulated wastes.

7.0 CONCLUSIONS/RECOMMENDATIONS

7.1 Summary of Industry Performance

Due to the previously discussed factors primarily arising from a significantly larger sample size, direct comparison of results may not always be straightforward, and must be considered in context. It is recommended to read the discussion after each section in order to consider the context and judge whether the calculated figures in this EPR are a real or apparent improvement or worsening due to direct actions by the processing sector or external forces independent of the industry's environmental goals.

Table 10: Summary of industry environmental performance indicators

<table>
<tr><th></th><th>Indicator</th><th>Units</th><th>2008/09</th><th>2013/14</th><th>2019/20</th><th>Comment</th></tr>
<tr><td rowspan="2">Water Use</td><td>Water use intensity</td><td>kL / t HSCW</td><td>9.4</td><td>8.6</td><td>7.9</td><td></td></tr>
<tr><td>Demand met by recycling</td><td>%</td><td>11</td><td>13</td><td>11</td><td></td></tr>
<tr><td rowspan="7">Wastewater</td><td rowspan="4">Untreated quality</td><td>P mg/L</td><td>42</td><td>33</td><td>30.4</td><td></td></tr>
<tr><td>N mg/L</td><td>233</td><td>250</td><td>174.5</td><td></td></tr>
<tr><td>BOD mg/L</td><td>3707</td><td>2657</td><td>2257</td><td></td></tr>
<tr><td>FOG mg/L</td><td>1593</td><td>1780</td><td>1143</td><td></td></tr>
<tr><td rowspan="2">Emissions quality</td><td>P mg/L</td><td></td><td>28</td><td>44.3</td><td></td></tr>
<tr><td>N mg/L</td><td></td><td>47</td><td>99.4</td><td></td></tr>
<tr><td>Discharged</td><td>kL / t HSCW</td><td></td><td></td><td>6.5</td><td></td></tr>
<tr><td rowspan="2">Energy Use</td><td>Total energy intensity</td><td>MJ / t HSCW</td><td>4108</td><td>3005</td><td>3316</td><td>Refer discussion in s 5.3</td></tr>
<tr><td>Electrical</td><td>kWh / t HSCW</td><td></td><td></td><td>336</td><td></td></tr>
</table>

	Thermal	MJ / t HSCW			2126	
	Renewables	%			0.4% of power 14.4% of thermal	Primarily from biogas
GHG Emissions	Emissions intensity	Kg CO2 e / t HSCW	554	432	397	Refer discussion in s 5.4.1
Solid Waste	Landfilled tonnage	Kg / t HSCW	11.3	5.9	11.9	Refer discussion in s 5.5
Local Amenity	Noise	# / site / yr	<1	<1	<1	
	Odour	# / site / yr	8.9	7.1	3.8	

In summary, the following conclusions are made regarding the processing sector's environmental performance from the data gathered in this survey:

1. Water use intensity was 7.9 kL / t HSCW. Compared to the last EPR in 2015, where a result of 8.6 kL / t HSCW was reported, this shows a reduction of water use intensity of 7.9% or 0.7 kL / t HSCW. Considering the 2008/2009 FY EPR where 8.7 kL / t HSCW was reported, this shows that the Australian red meat processing industry is continuing to achieve reductions in water intake.

2. The average site wastewater discharge volume calculated was 6.5 kL / t HSCW, a significant improvement of 2 kL / t HSCW on the 2015 figure of 8.5 kL / t HSCW, or 23.5%. Relative to the intake, this survey calculated 83% of water intake being discharged, compared to 99% in 2015. This suggests significant improvements in in-plant water usage.

3. The energy use intensity calculated in this survey was 3316.2 MJ / t HSCW, or a total increase of 10.4% compared to the 2015 value. The energy value associated with rendering was 1,223 MJ / t HSCW, meaning that for this sample size and excluding rendering the energy use intensity is 2092.9 MJ / t HSCW, or a 43% increase on the 2015 figure.

   This figure should be considered in the context of energy performance over time, where 2008/2009 energy intensity was 4,108 MJ / t HSCW. In addition, if the 2020 reduction in waste water discharges are partly attributable to improvements in waste water management, this may come at a cost to energy intensity.

4. On average, total site GHG emissions were 397 kg CO_2-e / t HSCW, an 8.1% reduction compared to the 2015 value of 432 kg CO_2-e / t HSCW.

5. The average figure for waste sent to landfill in this EPR was 11.9 kg / t HSCW, a very large increase of 102% compared to the 2015 value of 5.9 kg / t HSCW. Sites in this EPR reported a wider scope of wastes sent to landfill, whereas the 2015 figure was calculated for only solid waste sent to landfill. Sites did not break down the components of their general waste, however large volumes of liquids (e.g. waste oil, non-renderable blood, un-dewatered paunch) sent to landfill are believed to have skewed these results. Due to increases in state based landfill levies, it is not consistent with expectation that the processing sector has increased tonnages of wastes disposed to landfill. The context of the COVID period should also be considered here, where the demand for non-recyclable consumables would have contributed to additional landfilled waste.

6. Noise complaints were reported to be comparatively rare, at far below 1 per site per year. Of the 25 sites, only one reported receiving two noise complaints from a residential source. This continues the positive trend observed in the 2015 EPR of receiving very few noise complaints.

7. Odour complaints are relatively more common than noise complaints, with on average 3.8 per site per year reported, however a 46% reduction for 2019/20 was achieved compared to 2015, where 7.1 odour complaints per site per year were recorded, showing that the processing sector is making good progress in reducing odours.

1.2 Implications for Industry

The sample size of 25 processors across multiple states and large species only and mixed species processing encompasses 41.3% of annual HSCW tonnage throughput, with a good spread between smaller plants with a general trend towards medium to large plants. There was no significant evidence that plant size impacted environmental performance indicators, thus the results presented here are considered representative of the industry as a whole. As previously mentioned, the calculated performance indicators of the industry presented herein may be best interpreted in isolation and not rigorously compared to previous EPRs, due to the significantly greater response rate increasing the potential for outliers.

Large variation in responses between sites is indicative of the complex nature of managing resource and asset efficiencies in red meat processing, and also suggests that there is still room for improvement in future survey response & participation, as well as improvement in environmental performance across the entire processing sector.

There was little significant benefit demonstrated in the calculated performance indicators that was attributable to formal energy, water, emissions, or waste reduction targets. This suggests that these targets need to be further developed in-plant, with additional resources allocated towards monitoring and achieving these KPIs. One such way that the efficacy of these targets may be improved is by directly making higher management responsible for reductions in energy, water, emissions, and waste from meat processing or further incentivizing in-plant staff for the achievement of these targets.

The data collection for this project depended on voluntary participation of red meat processors and their capacity to supply data. The quality of responses existed on a spectrum, where it was apparent that some sites had better data systems than others, and even some sites within the same business outperformed others and had differences in environmental performance targets and achievements. This suggests that the environmental KPI targets are either left to individual sites, not clearly communicated, or not effectively incentivised.

With regards to the industry wide goal of CN30, the figure below shows a clear downward trend in the emissions intensity per business metric since 2009, however the rate of emissions reduction must accelerate via more invasive and proactive actions in order to progress towards carbon neutrality, noting that complete 'carbon neutrality' for processors will likely require some carbon emissions offsets or abatement.

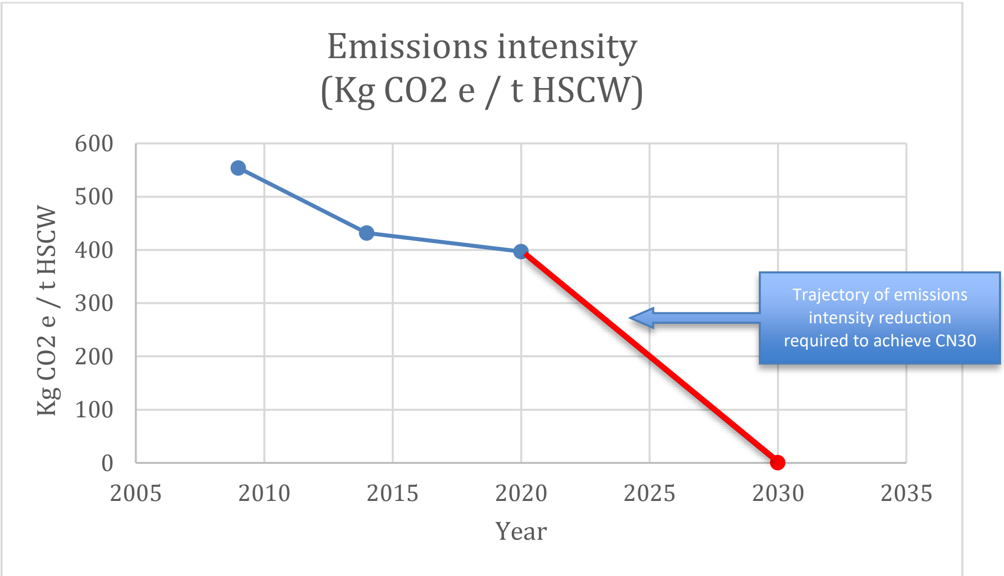


Figure 18: Trend in emissions intensity reduction showing increased action required to meet CN30 goal.

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