Project Report
Wagstaff Cranbourne Pty Ltd (Ralphs)
Carbon Footprint

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Executive Summary

The following tables provide an overview of the outcomes of the carbon footprint project.

Using the data provided by Ralph, the analysis indicates that:

Recommendations include:

1. Wastewater emissions estimating for NGER
   - Consider installing metering to accurately record volume of water entering anaerobic pond system
   - Continue with testing of water quality (COD) entering and leaving anaerobic ponds and SBR
   - Consider a once off sampling program of water quality (COD) entering anaerobic ponds, to track change in COD over a 24 hour period to determine how it varies, compare this with water volume to determine total COD load entering anaerobic pond system. This should be done on a day when grain fed cattle are being processed and again on a day when contract killing is being done
   - Consider installation of a continuous sampler for water quality entering anaerobic pond if Ralph's ends up getting close to NGER or CPRS thresholds
   - Once additional data is available, check to see which method provides the most accurate estimate of emissions, which will most likely be Method 2

2. Investigate options for mitigating risk of climate change, as outlined on section *2.8 Climate change risk management strategies*.

1. Overview of Carbon Footprint Project

This project was initiated to determine the carbon footprint of the Wagstaff Cranbourne (Ralphs) sites at Cranbourne and Garfield. The data collected was in line with requirements for the new National Greenhouse and Energy Reporting system (NGER).

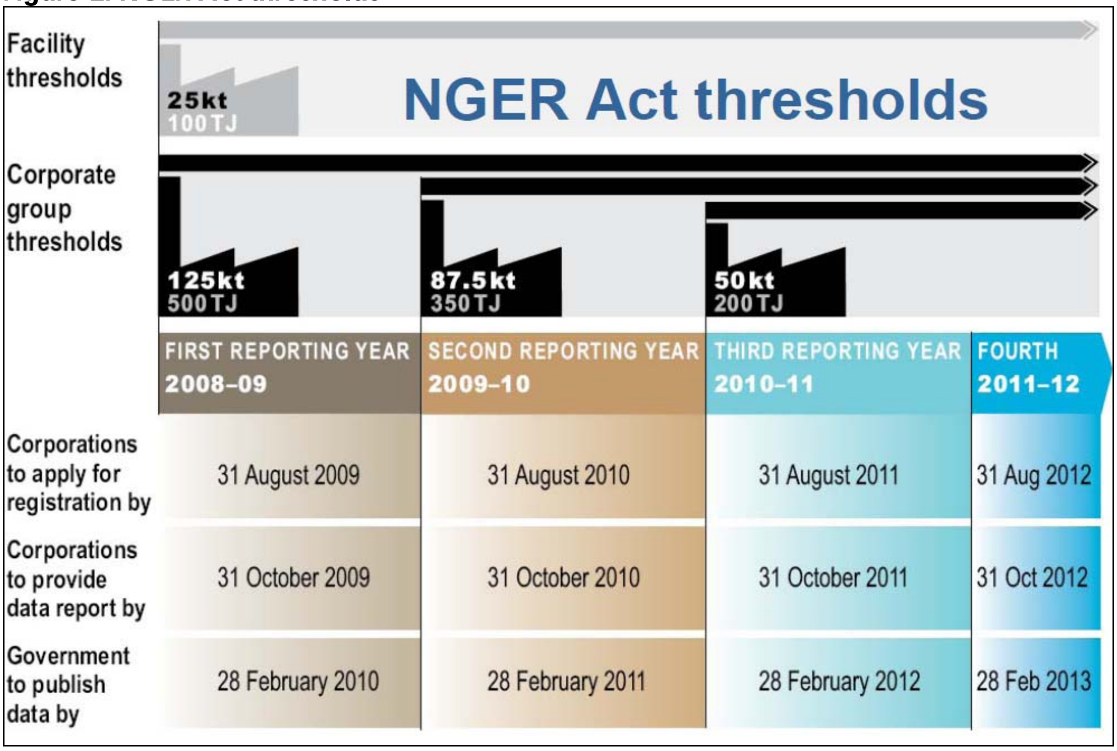
1.1 Background on regulations

There are currently a number of regulatory requirements relating to energy use, energy efficiency and greenhouse gas emissions which are relevant to the Ralphs sites.

The Energy Efficiency Opportunity Act (**EEO**) came into force in 2005, and the first trigger year was the 2005-2006 financial year. Corporate groups that exceeded the energy use threshold of 0.5 PJ are required to register for the program.

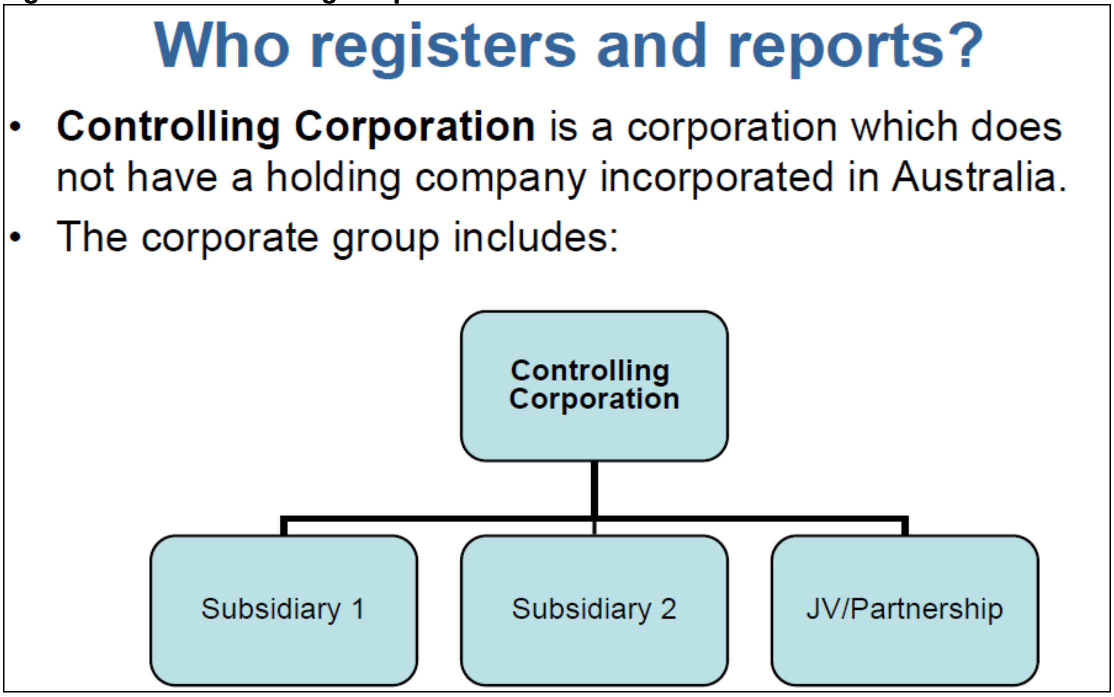
The National Greenhouse and Energy Reporting system (**NGER**) started on 1st July 2008. Individual sites with energy use greater than 100TJ (or 100,000,000 MJ) or greenhouse gas emissions of more than 25,000 tCO_{2-e} are required to register and report. Corporate group thresholds start at the same level as the EEO and then decrease over time to 50kt or 200TJ, as indicated in Figure 1.

Figure 1: NGER Act thresholds



NGER requires reporting for Scope 1 and 2 emissions. Scope 1 emissions are direct emissions that occur onsite and include boiler fuel use, transport fuels, waste, wastewater and refrigerant emissions. Scope 2 emissions are indirect emissions from the consumption of electricity. The Government expects 700 firms to be captured by the NGERs system. The diagram below indicates how the regulations view a controlling corporation, **which may be relevant for Ralphs or its parent company.**

Figure 2: NGER Controlling Corporation Rules



Further details on NGER requirements can be found at the website http://www.climatechange.gov.au/reporting/index.html

The data captured by the NGERs system will feed into the Australian Carbon Pollution Reduction Scheme (**CPRS**), which is due to start in 2010. For the CPRS, only direct onsite emissions (Scope 1 under NGER) are included and the threshold is 25,000 t $CO_{2\text{-}e}$. Given that the current proposal is for limited allocation of free permits to emissions intensive trade exposed companies (EITE companies) such as Ralphs (up to 30% of the total) and a probably permit value of $20-40 per tonne of carbon dioxide equivalent (t CO2-e), it is important for Ralphs to understand the extent of it's potential liability. Agricultural emissions are excluded from the CPRS until 2015, but how emissions from agriculture are handled in the system could also add to the regulatory and cost burden for Ralphs. At present, it is anticipated that downstream users of agricultural products, such as meat processing plants using livestock, will be the liable parties.

Victorian has a range of legislation relating to energy and greenhouse issues. The earlier Industrial Greenhouse Program required a Level 2 energy audit to be completed and action plans to be developed, approved by the EPA in December 2003 and completed by December 2006 for all EPA License holders.

The new Victorian Environment and Resource Efficiency Plans (EREP) legislation requires all sites using >100TJ of energy or > 120ML of water per financial year to develop and implement an action plan targeting water, energy and waste. Any identified action items with a payback period of less than 3 years must be implemented. Registration was required by 31 March 2008 and the action plans must be submitted by December 2008. So far, 250 sites across Victoria have registered, which account for about 45% of Victoria's energy use.

The Victorian EREP scheme is focused on consumption of energy and water, while the Federal NGER scheme is interested in energy consumption and greenhouse gas emissions, so includes emissions from waste and wastewater.

1.2 Data used

Consumption used in the carbon footprint project included:

- Electricity purchased off the grid and used onsite
- Natural gas purchased and used onsite for hot water generation (Stationery Energy)
- Transport fuels purchased and used
    - LPG for forklifts
    - Diesel for tractor
    - Petrol for company cars

Greenhouse emissions were calculated for the consumption outlined above, and for additional sources of emissions, namely:

- Emissions from the wastewater system
- Emissions from onsite waste management
- Emissions from the refrigeration system

Data was collected for the 2007-2008 financial year period for each of the above emission sources and was provided as a consolidated figure for that period by Andrew Ralph. One electricity bill for each site was sighted, and the natural gas bill for Cranbourne was sited. Transport fuel volumes were estimated using the annual fuel costs and assuming an average fuel cost per litre to calculate the volume.

For waste production and wastewater emissions, estimates were used. Wastewater volumes are not metered entering the anaerobic pond and SBR, so the metered figure for water purchased by the plant was used, and it was assumed that **100%** of this water ended up in the wastewater treatment system. It was assumed that **20%** of the water used at the plant is recycled water (which is used for stockyard washing, truck washing and cattle washing, which meant that the total flow into the anaerobic pond and SBR was xxx kL per year (based on the Apr07 – Mar08 fresh water consumption of xxxkL), which equates to about xxx kL per working day.

The Carbon Footprint project did not include:

- Emissions from livestock transport to the plant
- Emissions from product transport from the plant and between sites done by subcontractors
- Emissions from livestock at the plant or prior to delivery at the plant

These emission sources were excluded as they did not meet the "Operational Control" test outlined in the NGER requirements, namely that Ralphs does not have the ability to develop and implement Occupational Health and Safety or any other policy within the organisations such as the transport companies. Emissions from livestock at the plant were not included as there is not an agreed method for calculating these emissions.

1.3 Description of site operations

The Cranbourne site:

- Processes 300 head of cattle and 2,000 small stock (average 1,500 sheep and 500 lambs, calves sometimes replace sheep) every day. Sheep is 95% export, 5% domestic. Export is going offsite on a "hot program" at 15 °C, goes to a third party cold store which WC pays the bill for but which they don't control. Sheep going to domestic market is chilled, only minor amounts goes to Garfield, mostly offsite to wholesalers/boning rooms etc. Calf season is winter (rumen production)
- Works 5 days per week with one kill floor shift on each kill floor (small stock and large stock). There is a small boning room that cuts sheep carcasses into 6 way cuts, then boxes them for the Middle East market. About 50% of the beef goes to the Garfield site. The kill floor shifts runs from 6am to 3pm, and temperate boning/cutting room shifts run from 10am to 6pm. Cleaning runs from 3pm on the slaughter floor and finish at 11pm, boning room cleaning starts at 6pm and runs through until 11am. Night shift if emptying chillers into loadout, then clean up. Cleaning is done by WC staff.
- There is no onsite rendering, skins treating or laundry. Beef are injected with saline-like solution to maximise blood recovery.
- Is a domestic and export registered plant for Japan, some Middle East and Jamaica (majority to Middle East), so is subject to strict AQIS regulation with regard to food safety

- Products from the site include carcasses, boxed 6 way cut sheep, runners, rumen (from calves), chilled offal. Blood is transported offsite, cost $40 per tonne, about 20t per day (includes 5t/ day water, run saline solution through circ system + flush back)
- Has 1 annual shutdowns of 2 weeks around the Christmas-New year period. During this period, the cold store may be completely emptied, so refrigeration is turned off during this period. Plant is designed to allow individual rooms to be refrigerated, so electricity use for refrigeration during shutdown periods are minimised. This equates to about 46 working weeks per year, which at 5 days per week is about 230 working days per year, although during the drought there were also some Saturday shifts (6 days per week equates to 288 working days per year).

Stationery energy use at the Cranbourne site

- The Cranbourne site has 2 natural gas fired boiler than generate hot water of 990kW with a hot water ring main. Boilers operate at 4,200 MJ per hour on high fire (both on during slaughtering, 6 hours per day), and about 1,000 MJ per hour on low fire. The boilers are about 20 years old but was reconditioned about 2 years ago so that now they work on demand based on water pressure. The main water supply into the plant is metered with a local readout, there isn't currently any additional metering. Only use both boilers 2 days out of 7. All hot water is heated to 82°C, warm water is produced by blending with cold water.
- **Boiler feed water** system – used to meter, but not for the last few years
- **Hot water metering** currently not installed
- **No heat recovery currently installed**
- **Water recycling** includes
    - Final treated effluent is recycled back for yard and cattle washing
- **Water meters** are currently installed only on the main line into the plant

Electrical energy use at the Cranbourne site

- The **electricity** system has a transformer with a kWh meter (local readout only) for the feed coming into the plant
- **Refrigeration system** is mostly ammonia based, chillers are after kill floor, heat from system is dumped to cooling towers
- Other **refrigerants** include 3 Freon (R22) units, one does the boning room (409) (30kg), and one of each separate offal room

(30 kg and 20 kg). There are 2 refrigerated containers with R134a (4.5 kg and 4.5 kg)

- **Room temperatures**
  - Mutton slaughter floor room temperature is refrigerated
  - Boning room temperature is run at 10°C
  - Chillers after slaughter floor are run at 0°C, depending on what is in there. New AS is that meat has to reach 7°C surface temperature within 24 hours of stunning, stock normally come in at about 39°C
  - Loadout is 10°C
  - Use refrigerated shipping containers for holding offals & runners
  - Product from each days kill is loaded into chiller and loaded out from site on the next day once it has reached target temperature. There isn't a lot of onsite longer term storage at Cranbourne site
- **Product temperatures**
  - Sheep – 95% goes to export at 15°C, 5% of domestic chilled
  - Lamb – all domestic so all chilled to 5°C
  - Beef – 50% to Garfield, 50% to export
- **Variable Speed Drives** are not currently installed at the plant, they will shortly be installed on the mutton chain on the drive for the chain

Transport energy use at the Cranbourne site

- **LPG** is used for forklifts
- **Unleaded fuel** is used company cars
- **Diesel** is used for onsite transport

Water use & Wastewater treatment at the Cranbourne site

- Water from the kill floor and stormwater from the stockyards are directed to a screen, the solids collected and disposed of offsite. The water out of the screening (down to 10 -15mm) goes through a 2mm screen, then to a hydrocyclone. The fats and solids removed from the hydrocyclone are separated out and disposed of offsite, and the water out of the hydrocyclone goes to a flow splitter. The flow splitter send about 30% of the flow to a sequencing batch reactor (xxML capacity), and the remaining 70% is directed to an anaerobic pond (xxML capacity). The anaerobic pond is covered with a HDPE cover which has 2 vents and an access hole. The gases generated percolate through a biofilter built into the banks of the pond, ensuring that no odours result from the operation of the anaerobic pond. Water out of the anaerobic pond flows into the SBR, whose aerator is set by timer (9, 10 and 11 am on for 15 minutes, then operates continuously from 3pm to 11pm). The water out of the SBR siphons to the storage lagoon which has xxML capacity. Water out of the storage lagoon is treated with chlorine and directed to a holding tank at the plant, where it is used for stockyard washdown and cattle washing.

- Quality of water entering the anaerobic pond and SBR ranges from xx mg/L from extensive testing conducted during 2002/2003. The final effluent in 2002/2003 ranged from xx mg/L of COD, but testing from 18/9/08 indicated that the value for BOD was xmg/L and xmg/L for filtered, suspended solids of xx mg/L and no E Coli. Total nitrogen was xx mg/L, Total Kjendhal Nitrogen was xx mg/L and total phosphorus was xx mg/L.
- The anaerobic pond and SBR have been operating for about 8 years and have not been desludged yet, when they were designed it was expected that it would be 15 years before they required desludging. The anaerobic pond cover is expected to have a 10-20 year life and can be walked on for inspection, it costs $36K in 2000 but is showing evidence of hardening. The ponds are not lined and there has been some trouble with erosion of the banks of the SBR due to the action of the large aerator, but Ralphs has managed this issue by putting old truck curtains over the banks to provide a physical barrier. During the site visit, a substantial number of ducks were observed on the final pond.
- Fresh water usage during the period April 2007 – March 2008 was 60,281 kL, which equates to 262 kL/day (based on 5 day working week) or 209 kL/day (based on 6 day working week).
- The final treatment effluent is used for irrigation of neighbouring Ralphs properties, there is xx hectares available on the farm and x hectares available on a reclaimed quarry. During the period April 2007 – March 2008, xx ML of treated effluent was used for irrigation on the farm and xxML was directed to the sewer. There have been ongoing discussions with the EPA and South East Water about the site discharging all or part of their final and untreated wastewater to sewer, and this may be an option which is taken up in future. Irrigation is not permitted at the farm during the period May – October, only during November – April.

Waste handling & treatment at the Cranbourne site

Pens are elevated, so they do not need to be cleaned daily. Cleaning starts with a dry clean, the discharge to the wastewater system is blocked off and a vacuum truck in brought onsite to remove the material to the farm, where it is spread on the pastures.

Manure from the stockyards is composted onsite, as is the solids removed from the wastewater screening system and some of the sludge from the hydrocyclone. This was estimated by James Ralph to be about xt/day of paunch & manure, and when it is composted it is recycled back to the farm.

Current & Future plans at the Cranbourne site

Have a look at

1. Biogas capture and use, including new bioreactor

The Garfield site:

- Processes 50% of beef produced at Cranbourne site in boning room, kill floor is installed but not currently operational
- Works 5 days per week with 1 shift. The boning room shifts run from 6am to 3pm. Cleaning runs from 3pm and finish at 8pm. Cleaning is done by Ralphs staff.
- No onsite rendering, skins treating or laundry
- Product goes out as chilled to export, all the primal cuts are chilled onsite and the trim is sent offsite for freezing. About 600 pallets capacity (600 tonne) in chillers. One blast chiller installed but used for snap chilling rather than freezing (runs continuously)
- Is a domestic and export registered plant for Japan, Korea, China, Middle East and Chile, so is subject to strict AQIS regulation with regard to food safety.
- Has 1 annual shutdown, 2 weeks at Christmas-New year period ie equates to 46 working weeks per year. During this period, the cold store is generally not completely emptied, so refrigeration is often left on during this period.

Electrical energy use at the Garfield site

- Refrigeration system is 3 units of R22, which carry 25kg each, 3 more units running R404a with 30kg each. Maximum of 5 kg added per year at most between both plants.

Transport energy use at the Garfield site

- **LPG** is used for boiler hot water generation

Wastewater treatment at the Garfield site

- No primary treatment or secondary treatment at present, wastewater from process areas goes directly to ponds
- 3 ponds are installed in sequence, currently operating as aerobic due to low organic load from process (due to no killing, only boning)
- Final effluent is used for pasture irrigation as per EPA License requirements

Current & Future plans at the Garfield site

Ralphs are considering:

- Processing 200-300 head per day of beef

2. Results

2.1 Energy usage and Greenhouse emissions at the plants

Table 1 provides a summary of the results for the plants. Approximately 31% of the energy used onsite is electricity, while the majority is used as fuel for generating hot water.

In terms of greenhouse emissions, the total emissions from the site include direct onsite emissions (such as hot water generation and wastewater emissions) and indirect emissions as a result of electricity consumption. Direct (scope 1) emissions, which are to be included in the Carbon Pollution Reduction Scheme, were xx t CO_{2-e} and about xx% were due to emissions from the wastewater treatment system due to the conservative NGER methodology.

Table 1: Energy Use and Greenhouse Emissions Summary

	Cranbourne	Garfield	Total	Threshold
Total site energy use (TJ)				
Electricity % of total site energy				
Boiler fuel % of total site energy				
Production t HSCW				
Total tCO_{2-e} emissions+ (NGER)				
Direct (scope 1) tCO_{2-e} emissions				
% of direct emissions from wastewater				

+ note that wastewater emissions use the default NGER values, which are well above site values (this is covered in section 2.2).

Table 2 provides some indications of how the plants compare to industry averages. All key performance indicators were well below published industry averages.

Table 2: Key Performance Indicators compared to Industry averages

	Cranbourne	Garfield	Industry
Electricity kWh/tHSCW			200*
Total energy MJ/tHSCW			1,800*
Greenhouse kg CO2-e/tHSCW			525

* MLA Environmental Best Practice Guidelines for the Red Meat Processing Industry, for domestic kill and chill operations with no rendering

2.2 Wastewater emissions

The NGER system currently has 3 different allowable calculation methods. Method 1 is the simplest and requires only the production rate (t HSCW) to calculate wastewater emissions, as it uses industry defaults for the other values such as the volume (kL water/ t HSCW), quality (mg/l COD into pond system) and fraction degraded anaerobically. Method 2 uses actual plant data for volume and quality, but requires COD rather than BOD readings. If COD readings are not available, then the BOD value must be multiplied by a factor of 2.6, which could lead to an overestimation in emissions as the factor is usually more likely to be 1.4 for meat plants.

Table 3 compares the default values provided by the NGER legislation with the actual values for the Cranbourne site. As the performance of the site is well below industry averages and the quality of the water going into the anaerobic pond is very good compared to industry averages, using the NGER default values overestimates the greenhouse emissions from the wastewater system by a factor of 33.

Table 3: Comparison of NGER and actual site values for wastewater

	Cranbourne	NGER value
kL water/tHSCW		
COD mg/L		
Anaerobic removal of COD		
Resulting safety factor		
Resulting tCO2-e emissions		

To be able to use NGER Method 2, which would be more appropriate, Ralphs would have to have

1. continuous flow monitoring into the pond system ie combined flow into the anaerobic and SBR ponds
2. COD monitoring at least monthly on inlet to anaerobic pond and outlet of anaerobic pond and SBR
3. results from sampling program providing that COD monitoring is “representative”

2.3 Biogas generation and capture

The table below provides an indication of the potential biogas generation rates based on current water volumes and qualities. As Ralphs have done a lot of work installing wastewater treatment upstream of the ponds, the water quality going into the pond is fairly good. From a biogas generation perspective, this means that there is less of a resource available to convert to methane.

Table 4: Biogas generation potential at Cranbourne site

Wastewater Biogas Generation	
Water volume into pond (kL/year)	
COD into pond (mg/L maximum)	
Total COD load (kg COD/yr)	
% COD removed in anaerobic pond	
% methane captured	
COD to methane conversion factor * (kg methane per kg COD removed)	
Maximum methane generation potential (kg)	
Methane density kg/m^3	
Methane calorific value MJ/m^3	
Maximum bioenergy available (MJ/year)	
Cost saving based on $6.50/GJ for natural gas	
Cost saving based on $40/tCO2-e for greenhouse offset	
Current natural gas consumption at Cranbourne (MJ/year)	
Biogas % of current Cranbourne site natural gas consumption	

* data taken from NGER wastewater method (5.3 tCO2-e per tonne COD removed)

According to a recent Victorian Government report, small anaerobic digestors are commercially available and generally prefer a constant volum and concentration of feed material, with a preference for material with a high nitrogen and low lignin content. A nitrogen management study conducted at Dinmore indicated that waste streams with high COD which would be good candidates for inclusion in a bioreactor included:

- cattle yard wash streams, including manure
- tripe processing effluent
- dry dump streams
- red offal wash streams & offal processing
- casing processing

In addition, wastewater from the kill floor was a relatively high volume and high temperature, which may also make it an ideal candidate.

Funding may be available from the Victorian Government **Sustainability Fund**, details are available at http://www.sustainability.vic.gov.au/www/html/2387-priority-statement-.asp , or the **ResourceSmart Business Program** in terms of undertaking a feasibility study, details are available at http://www.sustainability.vic.gov.au/www/html/2716-resourcesmart-business-program.asp . CRF Colac and Midfield have successfully obtained funding through the latter program.

2.4 Future plans – Garfield Beef Kill

Plans are being considered to process 200-300 head of beef at the Garfield site. The following is an estimate of the additional energy consumption and greenhouse emissions which will result. xxxxx

Table 5: Impact of Garfield beef kill on energy use and greenhouse emissions

	200 head per day	300 head per day
Kg HSCW per head		
t HSCW per year+		
Extra Electricity kWh (xx kWh/tHSCW*)		
Electricity MJ equiv		
Electricity tCO2-e equiv		
Extra boiler fuel MJ (xxxMJ/tHSCW*)		
Extra boiler fuel t CO2-e equiv		
Extra wastewater tCO2-e#		
Total extra MJ		
Total extra tCO2-e		
Total extra tCO2-e direct (not elect)		
Total WC Energy (TJ)		
Total WC tCO2-e		
Total WC tCO2-e direct (for CPRS)		

+ based on 5 days per week, 46 weeks per year
* based on current Cranbourne figure
# based on NGER rules which look only at t HSCW

2.5 Water reuse & wastewater management opportunities

The Cranbourne plant is already using recycled, treated & chlorinated effluent for stockyard washing, truck washing and cattle washing. Other options for water reuse include matching water with a “lower grade” user such as:

Source	Potential reuse
Freezer/ chiller defrost	Cooling tower makeup
Knife & equipment sterilisers	Stock washing
Handwash basins	Sprays on trammel screens
Head wash	Gut washing

* Eco-Efficiency Manual for Meat Processing, p55

Other ways of reducing potable water consumption could include:

- countercurrent washing on viscera table ie recycle water from clean end to dirty end
- spray sterilisers in boning rooms
- efficient spray nozzles on hoses, higher pressure water for cleaning
- flow control on sterilisers eg flow restrictors

- efficient shower roses for offal washing + on/off controls at washing stations
- rainwater harvesting eg for cooling tower makeup

In terms of **optimising pond performance**, there are 2 key issues
1) reducing salt levels going into the ponds, to ensure final effluent quality meets required TDS levels
2) optimising SBR performance eg install first flush system on runoff from sealed areas, so that first flush which contains most contaminants is directed to anaerobic pond/SBR, but then remainder of flows is directed into holding pond. At the moment, it appears that rainfall is reducing residence time in the SBR and may be leading to elevated levels of nitrogen in the final effluent

AMPC currently has funding available ($40K per site) for innovative water reuse projects.

2.6 Cogeneration

Current peak electrical capacity is 524kW, with average of 209kW (based on Jun08 bill) and hot water generating installed capacity is 1980kW.

The Heat to power ratio is therefore about 3.8 at peak, 9 during non-peak, and hot water is required, so reciprocating engines may be the best technical fit. If sized to meet site heat requirement, it would mean that excess electricity was available for export to the grid, although this is generally not economic unless the local electricity network is constrained and network support payments are available. Metropolitan location may mean that a Build-Own-Operate contract is feasible, and gas engine could be selected to enable cofiring of captured biogas with natural gas.

2.7 Future trends

These results represent a snap shot of the sites at a point in time. It is important to consider that there are a number of impacts which are likely to change these figures in future, most of which point to these benchmarks increasing over time due to factors which are largely outside the control of the company.

Table 6: Factors likely to influence key performance indicators

Energy type	Factor	Change	Likely impact on usage	Controlled by site?
Electricity	Level of automation	Likely to increase due to o increasingly stringent OH&S and Quality requirements o increasing labour costs and constraints on labour availability	Electricity consumption will increase per unit of production as tasks which are currently done manually are in future done by machines	Partly
	Refrigeration load due to climate change	Likely to increase due to o increase in average ambient temperatures o increase in humidity, particularly in northern half of Australia	Electricity consumption will increase per unit of production	No
	Power quality and reliability	Likely to decrease due to o increasing frequency and severity of storms due to climate change o increasing peak demand due to growth in residential HVAC o peak demand for meat processing sites coincides with peak electricity network demand (ie hot summer afternoons)	Electricity consumption may increase due to increased frequency of brownouts/ blackouts, requiring plant restarts, particularly for sensitive electronic equipment eg boning room	No, unless onsite power generation installed
	Increased competition for coal due to demand in China	Likely to increase price of electricity	Increases pressure to reduce usage	No
	Inclusion of carbon cost at about $40/tCO_{2-e}$	Likely to increase price of electricity	Increases pressure to reduce usage	No
	Retailer contracts and billing ie cost	Likely to increase due to • increase in effective “penalty” for poorer load factors and peak usage occurring at some time as system peak • possible inclusion of summer peak power demand charges or time of use charges to cover peak periods	Increases pressure to reduce usage through • permanent demand reduction ie energy efficiency • load shedding or load shifting to offpeak periods • embedded generation eg cogeneration to reduce site peak load • power factor correction	Retail contracts

Energy type	Factor	Change	Likely impact on usage	Controlled by site?
Boiler fuel	Food safety & quality requirements	Likely to become more stringent and limit the amount of recycling and reuse options available, particularly for export plants	Likely to increase hot and warm water use, which will in turn increase boiler fuel consumption due to • additional clean down • additional separation of byproducts/wastes	No
	Inclusion of carbon cost at up to $40/ t$CO_{2-e}$	Likely to increase price of electricity	Increases pressure to reduce usage	No

2.8 Climate change risk management strategies

Given the potential financial impact of climate change, some potential strategies for managing risk are listed.

Risk management strategy 1. Switch to lower emission fuel source	Potential saving
• **Biomass** firing or cofiring of boiler o find local (<100km) source of biomass eg wood, woody weeds, crop residues o may be seasonal o may be competition from other users eg sugar mill cogeneration plants o may be eligible for various grants o energy density of wood/biomass ranges from 40-60% of coal, so will mean 1.7 – 2.6 times the volume relative to coal. Local biomass sources may have higher energy content than average eg macadamia nut shells	**Short rotation coppicing** yields about 5-30 dry tonnes per hectare per year depending on planting and harvesting cycles, with an energy content of 16 GJ/dry tonne ie 80 – 480 GJ per hectare per year.
• **Biogas** capture from anaerobic ponds o May not be feasible to include in boiler o may be able to use in separate dedicated generation set to produce electricity o may be able to use in other applications with modification to combustion equipment eg render plant blood drying system, laundry boiler fuel o may be eligible for various grants	Generally only capture about 75% of methane generated, generation rates depend on COD into pond
• **Biodigester** o May be able to take paunch, manure, wastewater o may be eligible for various grants	
• **Natural gas cogeneration** o Cogeneration plants less than 3-5MWe size tend to be recip engines, about that size gas turbine may be economic although they can produce higher pressure steam which has no use onsite. Costs range from $1.2K - $2K per kW. **Will need careful assessment as may lead to increase in site emission depending on size of plant, as electricity emissions are currently excluded under the CPRS** o Cogeneration plant sizing options include ▪ Match to peak electrical load, would require export in non-peak periods ▪ Match to essential electrical services load eg chillers and freezers, so no product is lost in event of grid failure ▪ Match to heat load, which may mean	Current peak electrical capacity is xxxKW, with average of xxxkW (based on Jun08 bill), HWG installed capacity xxxkW. Heat to power ratio therefore about xx at peak, x during non-peak, and low pressure steam required, so recip engines may be best technical fit and if sized to meet heat requirement, would mean excess electricity was available for export to the grid.

Risk management strategy	Potential saving
• **Solar preheating** of hot water system o May be grant available	From Eco-efficiency manual, 2 year payback for natural gas
2. Use more efficient technology	
2.1 Thermal Energy Generation systems	
Optimise efficiency of thermal energy plant by • insulating tanks and pipework • installing economiser to recovery energy from HWG stack gases • optimising heat recovery and heat transfer systems, such as heat exchangers	Refer to Appendix 1
2.2 Thermal Energy Distribution systems	
Optimise efficiency of distribution system by • insulating pipes and tanks • removed dead legs/redundant piping	Refer to Appendix 1
2.3 Thermal Energy End use systems	
3 key strategies for reducing end use of thermal energy 1. Use most efficient equipment possible 2. Use equipment as designed 3. Ensure equipment is only on/using energy when required Examples include: • Reducing required temperature of hot water, by minimising losses in pipework/tanks	Refer to Appendix 1
2.4 Electrical Energy End use systems	
Consider installing power factor correction	Refer to Appendix 1
Consider additional locations for more efficient equipment such as variable speed drives	

Risk management strategy	Potential saving
3. Increase amount of heat recovery	Refer to Appendix 1
Key areas to focus on are: • Heat recovery back to boiler feedwater system eg from wastewater streams • Condensate recovery back to boiler feed system (also minimises boiler feedwater treatment costs) • Heat recovery from rendering plant to minimise extra steam required for hot water system Ideally, site would end up with a matched system so that heat recovery from rendering meets hot and warm water needs of plant without extra additional steam	
4. Reduce organic load on pond system	
Key areas include • Reducing the amount of fat and blood that get into drains • xxxxx If biogas capture is going to be implemented, focus on removing suspended contaminants, as dissolved contaminants could increase amount of biogas generated (whereas suspended contaminants may cause sludging problems in pond)	Detailed analysis of cost and benefits required
5. Offsets	
5.1 Sequestration using trees (permanent forest) Trees can sequester between 3 – 35 tCO2-e per hectare per year, depending on number of trees planted per hectare, quality of site preparation, management of plantation, ongoing pest, fire and disease management. Forest Sink Abatement projects need to be accredited using accepted Australian methodology, such as the AGO Greenhouse Friendly scheme. Forest for greenhouse purposes must 1) be of trees with a potential height of at least two metres and crown cover of at least 20% 2) be in patched greater than 0.2 hectare and a minimum width of 10 metres 3) have been established since 1Jan1990 on land that was clear of forest at 31Dec1989 4) be established by direct human induced methods such as planting, direct seeding or the promotion of natural seed sources. Forest must be maintained for at least 70 years	AGO has produced detailed information to assist, will depend on what scale operation site want to implement, does not have to be at same physical location at plant and can be a co-operative arrangement with external landowners

Risk management strategy	Potential saving
5.2 Offset using other accredited schemes – either as a purchaser of accredited greenhouse offsets credits or a generator of credits. Greenhouse Friendly Scheme is one of the few Australia accredited schemes for offsets. Currently approved products include AGL Green Balance™ , BP Global Choice™ , Carbon Planet , Cascade Green , Dulux Aquanamel® and EnvirO2™ , Energetics, Envi Paper Products , Goldman Sachs JBWere , Jetstar , Lion Nathan Barefoot Radler Beer , Mystique Print , Origin Energy GreenEarth Gas , Qantas , Renewtek Pty Ltd , Sunrise Television Programme , Sustainable Living Fabrics , Earth Friendly power from Synergy , Virgin Blue Airlines Pty Ltd	Depends on how many offset credits are purchased, in theory now that Australia is a signatory to the Kyoto protocol, credits could be purchased for any accredited exchange that meets IPCC requirements eg Chicago Climate Exchange
5.3 Purchase accredited Greenpower for electricity supply	Depends on what % of purchased electricity is sourced from Greenpower.

Possible sources of funding for projects include:

Federal Government	
• Retooling for Climate Change (AusIndustry)	for projects that improve the energy and/or water efficiency of production, grants of between $10,000 and $500,000, up to a maximum of one third of the cost of each project, more details here
• Climate Ready Program (AusIndustry)	support for research and development, proof-of-concept and early-stage commercialisation activities, more details here
• Other AusIndustry programs	Details are here
• Renewable Energy Demonstration Program (DRET)	$435 million over seven years towards demonstration of renewable energy at a commercial scale that aims to facilitate market entry, will result in refinement of technology design, manufacturing, and operational cost parameters & deployment of large scale renewable technologies that will leverage significant private sector finance, more details here

3. Recommendations

1. Wastewater emissions estimating for NGER
    - Use Method 1 for 2007-2008 period
    - Install metering to accurately record volume of water entering anaerobic pond system (ie 2 locations)
    - Continue with testing of water quality (COD) entering and leaving anaerobic ponds
    - Consider a once off sampling program of water quality (COD) entering anaerobic ponds, to track change in COD over a 24 hour period to determine how it varies, compare this with water volume to determine total COD load entering anaerobic pond system. This should be done on a day when grain fed cattle are being processed and again on a day when contract killing is being done
    - Consider installation of a continuous sampler for water quality entering anaerobic pond
    - Once additional data is available, check to see which method provides the most accurate estimate of emissions

2. Investigate options for mitigating risk of climate change, as outlined on section 0*2.8 Climate change risk management strategies*.

4. References

Commonwealth of Australia 2008, "Energy Savings Measurement Guide: How to Estimate, Measure, Evaluate and Track Energy Efficiency Opportunities", v1May08

Meat and Livestock Australia (MLA) 2002, "Eco-Efficiency Manual for Meat Processing", Meat and Livestock Australia, Sydney

Meat and Livestock Australia (MLA) 2005, "Industry environmental performance review – integrated meat processing plants", PRENV.033, April 2005, ISBN 1 74036 620 4, Meat and Livestock Australia, Sydney

Appendix 1 – Potential opportunities

Taken from Eco-Efficiency Manual for Meat Processing and National Framework for Energy Efficiency review of meat processing sector

Utility	Process Equipment	Opportunity (note - section and page numbers refer to Eco-Efficiency Manual)	Payback (yrs)
Water	Stock washing	Minimise receipt of very dirty stock through contract clauses (section 2.2.3, pg 28)	0
Water	Stockyard washing	Dry cleaning manure before washing (section 2.2.6, pg 29)	0
Water	Viscera (and bleed) table wash sprays	Use of chlorinated detergents instead of hot water for cleaning viscera tables (section 2.2.12, pg 33)	0
Water	Plant cleaning	Improved dry cleaning prior to wash down (section 2.2.30, pg48)	0
Steam	Reduce steam demand	Reduce water entrainment in rendering materials (section 3.2.1, pg60)	0
Steam	Efficient steam raising	Fix steam leaks (section 3.3.3, pg 63)	0
Steam	Alternative fuel sources	Convert LPG boiler to tallow (section 3.4.2, pg 67-68)	0
Electricity	Refrigeration	Turn off refrigeration at night (section 3.6.4, pg 79)	0
Electricity	Compressed air	Improving efficiency of air compression by fixing leaks (section 3.6.6, pg 81-82)	0
Electricity	Process Equipment	Improve operating practices to minimise energy waste (eg breaks, out of hours)	0
Electricity	Packaging	Improve operating practices to minimise energy waste (eg breaks, out of hours)	0
Electricity	Refrigeration & Freezing	Switch off equipment/ cold stores/ freezers when not used or where operations are seasonal	0
Steam	Efficient steam raising	Rationalisation of boiler use (section 3.3.1, pg62-63)	0.1
Water	Alternative sources	Rainwater harvesting for cooling water or stockyard washing (section 2.4.1, pg56)	0.1
Steam	Efficient steam raising	Fine tune boiler operation (section 3.3.6, pg 65)	0.2
Water	Casings washing	Limiting water use in casing washing by interlocking the operation of the machine to a timer switch (section 2.2.25, pg44-45)	0.3
Water	Water sprays	Fit efficient spray nozzles (section 2.2.1, pg 25-26)	0.3
Water	Knife and equipment sterilisers	Flow control of continuous flow sterilisers (section 2.2.14, pg 36-37)	0.3
Water	Plant services - boiler	Maximise condensate recovery (section 2.2.36, pg52-53)	0.3
Electricity	Refrigeration	Improve efficiency of refrigeration compressors (section 3.6.2, pg 78)	0.3

Utility	Process Equipment	Opportunity (note - section and page numbers refer to Eco-Efficiency Manual)	Payback (yrs)
Water	Water supplies	Centralise control of water supplies, to supervisor can switch off during breaks (section 2.2.2, pg 26-27)	0.4
Water	Viscera (and bleed) table wash sprays	Intermittent flow for viscera (bleed) table wash sprays, only when table moves forward (section 2.2.9, pg 31)	0.4
Steam	Efficient steam raising	Insulate steam lines (section 3.3.4, pg 63-64)	0.5
Electricity	Refrigeration & Freezing	Maintain cold room and tunnel freezers fully sealed when not required	0.5
Fuel	Hot Water	Reduce hot water usage using efficient nozzles, trigger action hoses	0.5
Fuel	Process Equipment	Maximise loading of render plant cookers, and rotate to even steam demand	0.5
Water	Viscera (and bleed) table wash sprays	Setting and maintaining minimum flow rates for viscera (bleed) table wash sprays (section 2.2.10, pg 32)	0.6
Water	Paunch dumping (beef)	Dry dumping of paunch contents (section 2.2.23, pg43-44)	0.8
Water	Edible offal washing	On/off control of flow (section 2.2.28, pg46-47)	0.8
Water	Stock washing	Avoid under-utilisation of spray capacity (section 2.2.4, pg 28)	1
Water	Stock washing	De-dagging at feedlot to avoid stock washing at domestic plants (section 2.2.5 , pg 28-29)	1
Water	Knife and equipment sterilisers	Efficient continuous flow sterilisers (double skinned, water jacket etc) (section 2.2.13, pg 33)	1
Water	Carcase washing	Water sprays on splitting saws to remove bone dust and reduce carcase washing (section 2.2.19, pg41)	1
Water	Tripe and bible washing	Efficient water use in tripe and bible washing machines (section 2.2.24, pg44)	1
Water	Gut washing	Water efficient gut washing systems (immersion washer) (section 2.2.26 , pg 45)	1
Water	Water reuse	Reuse of clean wastewater streams (section 2.3.1, pg54)	1
Steam	Heat recovery	Optimise heat recovery from rendering, recover heat to produce hot water (section 3.5, pg 73-76)	1
Electricity	Lighting	Energy efficient lighting (section 3.6.11, pg 85)	1
Electricity	Refrigeration	Reduce heat ingress to refrigerated areas (section 3.6.1, pg 77)	1.1
Water	Carcase washing	Sensor control of automatic carcase washing (section 2.2.18, pg 39-40)	1.5
Water	Amenities	Automatic controls for hand washing (section 2.2.35, pg 51-52)	1.5
Electricity	Compressed air	High-efficiency air compressors (section 3.6.7, pg 82)	1.5

Utility	Process Equipment	Opportunity (note - section and page numbers refer to Eco-Efficiency Manual)	Payback (yrs)
Water	Plant cleaning	High pressure water ring main for cleaning (section 2.2.31, pg49)	2
Water	Plant cleaning	Automatic washers for tubs, cutting boards and trays (section 2.2.32, pg 50)	2
Water	Plant services – cooling tower	Conductivity controlled blowdown on cooling towers (section 2.2.37, pg53)	2
Electricity	Motors	Variable speed drives (section 3.6.9, pg 83-84)	2
Electricity	Services	Implement lighting controls eg in vacant areas, offices, carcass storage	2
Electricity	Services	Optimise heating, air conditioning controls and setpoints	2
Fuel	Hot water	Maintain hot tank/well and line insulation, repair leaks	2
Electricity	Services	Variable Speed Drive control of boiler fans	2.5
Fuel	Steam system losses	Maintain steam traps, optimise condensate return, insulate valves, flanges and lines, remove dead legs, repair all leaks	2.5
Steam	Efficient steam raising	Rationalise steam lines (section 3.3.5, pg 64)	2.6
Water	Plant cleaning	Floor cleaning machines for large areas (section 2.2.33, pg 50)	3
Electricity	Process Equipment	Variable Speed Drive control and automation of pumps (eg carcass washwater, wastewater pumps)	3
Electricity	Refrigeration & freezing	Automate chiller temperature profile control and implement fan speed controls	3
Electricity	Refrigeration & freezing	Optimise condenser operations eg pressure reduction using fan speed control, purging operations	3
Electricity	Refrigeration & freezing	Optimise ancillary equipment eg Variable speed drive for cooling tower fans, cooling and chilled water, refrigerant pumps	3
Fuel	Boiler losses	Install oxygen trim control	3
Electricity	All electricity	High efficiency motors	3
Water	Stockyard washing	Suspended mesh flooring (sheep + non-feedlot cattle) (section 2.2.8, pg 30)	3.3
Electricity	Alternative Sources	Cogeneration (section 3.7, pg 86-87)	3.5
Steam	Alternative fuel sources	Biogas from anaerobic ponds (section 3.4.3, pg 69)	4
Electricity	Refrigeration & freezing	Optimise compressor performance eg staging controls, variable speed drive controls, electronic expansion control	4

Utility	Process Equipment	Opportunity (note - section and page numbers refer to Eco-Efficiency Manual)	Payback (yrs)
Fuel	Boiler losses	Automate blowdown on TDS and recover heat to boiler feedwater tank	4
Fuel	Process Equipment	Cover surface, insulate and recover heat from scalding tank water	4
Electricity	All electricity	Energy monitoring and control	4
Electricity	Refrigeration	Evaporative cooling of carcases (section 3.6.3, pg 78)	4.8
Water	Cooling water on breaking saws	On/off controls for cooling water on breaking saws (section 2.2.20, pg 41)	5
Electricity	Services (lighting)	Best practice lighting technology	5
Electricity	Refrigeration & Freezing	Use conventional refrigeration rather than cryogenic freezing where feasible	5
Fuel	Hot water	Heat recovery from refrigeration superheat to pre-heat hot water	5
Fuel	Boiler Losses	Install economiser on boiler flue gas	5
Fuel	Process Equipment	Heat recovery from render plant cooker exhaust	5
Electricity	Refrigeration & Freezing	Optimise design of blast tunnel fans	6
Fuel	Boiler Losses	Upgrade to a high efficiency modulating burner with low turn down ratio	7
Steam	Reduce steam demand	Automatic diversion valves in bleed area to avoid dilution of blood (section 3.2.2, pg61)	10
Electricity	Refrigeration & Freezing	Upgrade to high efficiency, multiple stage refrigeration plant	10
Water	Pig scalding	Alternative scalding systems – water circulation spray scalding, steam scalding and condensation scalding (section 2.2.21, pg 41-42)	when replacing equip
Steam	Alternative fuel sources	Solar pre-heating of coal fired boiler feedwater (section 3.4.4, pg 72)	12
Steam	Alternative fuel sources	Solar pre-heating of gas fired boiler feedwater (section 3.4.4, pg 72)	2
Electricity	Refrigeration	Energy-efficient freezing systems (plate freezers rather than blast tunnel freezers (section 3.6.5, pg 80)	when replacing equip
Water	Stock washing	Timer controls for stock washing (section 2.2.7, pg 29) - prone to tampering?	

Utility	Process Equipment	Opportunity (note - section and page numbers refer to Eco-Efficiency Manual)	Payback (yrs)
Water	Viscera (and bleed) table wash sprays	Use of warm water instead of hot water (section 2.2.11, pg 32) - hygiene limitations?	
Water	Knife and equipment sterilisers	Spray sterilisers for knife or equipment cleaning (section 2.2.14, pg 36-37) - can use same amount of water as well-designed continuous flow steriliser??	
Electricity	Motors	Avoid over-capacity motors (section 3.6.8, pg 83)	
Electricity	Motors	Optimising piping layout to reduce pumping load (section 3.6.10, pg 84)	