Project Report
Kilcoy Pastoral Company (KPC)
Carbon Footprint

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Date: October 2008

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Executive Summary

The following tables provide an overview of the outcomes of the carbon footprint project. The information provided indicates that

- KPC will be required to register for the NGER system during the first trigger year (Jul08 – Jun09). Once KPC exceeds the 100TJ threshold, it would be advisable to register.
- KPC will exceed the threshold for the Carbon Pollution Reduction Scheme, so using current data will be required to participate when the scheme begins in 2010. If KPC wants to avoid this, it will need to implement carbon pollution reduction strategies
- Key Performance Indicators are lower than industry averages, but this could be in part due to use of offsite refrigerated storage for part of the production
- Summer electricity use is slightly higher, as would be expected
- Coal will increasingly become more expensive due to export pressures and inclusion of the cost of carbon post 2010. This may require a rethink of thermal energy needs
- As the anaerobic ponds are close to the plant, there is potential to modify the existing pond system to capture biogas and use it in the plant. This would assist with reducing site emissions to below the CPRS threshold. The potential biogas generation rate equates to about 20% of boiler fuel usage or about 14% of electricity use (if used in a cogeneration plant to generate electricity)

Table 1: Energy Use and Greenhouse Emissions Summary

	2007-2008
Total site energy use (TJ)	180
Electricity % of total site energy	31
Boiler fuel % of total site energy	69
Production t HSCW	56,132
Total tCO_{2-e} emissions	42,682
Direct (scope 1) tCO_{2-e} emissions	28,551
% of direct emissions from wastewater	35

Table 2: Key Performance Indicators compared to Industry averages

	2007-2008	Industry
Electricity kWh/tHSCW	280	300*
Total energy MJ/tHSCW	3,255	3,389+
Greenhouse kg CO2-e/tHSCW	453	525+

* MLA Environmental Best Practice Guidelines for the Red Meat Processing Industry,
+ MLA Industry environmental performance review, April 2005

Recommendations include:

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 efficiency projects such as

   - Remove steam injection from hot water storage tank, replace with steam heat exchanger on outlet of tank after pump
   - Insulation of hot water storage tank
   - Optimisation of pond system to allow for biogas capture and use in coal fired boiler or new, smaller gas fired boiler
   - Cogeneration using biogas capture from anaerobic wastewater treatment ponds or natural gas

3. Investigate options for mitigating risk of climate change, as outlined on section 2.6

1. Overview of Carbon Footprint Project

This project was initiated to determine the carbon footprint of the Kilcoy Pastoral Company (KPC) site. The data collected was in line with requirements for the new National Greenhouse and Energy Reporting system (NGER) and provides the energy baseline energy, energy cost and some data analysis for the Energy Efficiency Opportunities Act requirements.

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 KPC site.

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. 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, where the emissions do not occur onsite. The Government expects 700 firms to be captured by the NGERs system.

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-e}. Given that the current proposal is for limited allocation of free permits to emissions intensive trade exposed companies (EITE companies) such as KPC (up to 30% of the total) and a probably permit value of $40 per tonne of carbon dioxide equivalent (t CO2-e), it is important for KPC 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 KPC. At present, it is anticipated that downstream users of agricultural products, such as meat processing plants using livestock, will be the liable parties.

1.2 Data used

Consumption included in the carbon footprint project included:

- Electricity purchased off the grid and used onsite
- Boiler fuel purchased and used onsite (Stationery Energy)
  - Black coal for the boiler
- Transport fuels purchased and used onsite
  - LPG for forklifts
  - Diesel for tractor
  - Petrol for company cars
- Carbon dioxide used for dry ice

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 on a monthly basis for each of the above emission sources. For energy consumption, data was taken directly from bills from suppliers, so should be accurate.

For waste production and wastewater emissions, estimates were used. Wastewater volumes are not metered entering the anaerobic ponds, 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 350kL of recycled water was used each working day.

The Carbon Footprint project did not include:

- Emissions from livestock transport to the plant
- Emissions from product transport from the plant
- Emissions from solid waste treated offsite by waste treatment company
- Emissions from cold store in Brisbane which is used for overflow storage
- Emissions from transport of product to and from the cold store in Brisbane
- 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 KPC 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 Kilcoy Pastoral Company (KPC) site:

- Processes 570 head of cattle every day
- Works 7 days per week with one kill floor shift(5 days per week) and 2 boning room shifts processing only carcasses from the kill floor (only 1 morning boning shift on weekends). Kill floor shift runs from 6am to 5pm, and boning room shifts run from 5am to 4pm and then 4.30pm to 12 midnight. Cleaning runs from 6pm on the slaughter floor and finish at 3am, boning room cleaning starts after boning finishes eg 12.30am and runs through until 4am. Cleaning is done by KPC staff. From Sunday until Thursday, grain fed cattle from feedlots are processed. On Friday and Saturday, older, grass fed cattle (“cracker cows”) are contract killed.
- Onsite rendering plant processes only material from onsite operations, operates from 6am until 2am each working day (7 days per week), and produces meat meal, dried blood, concentrated ox gall and tallow (non-edible).
- Is a domestic and export registered plant for Korea, Japan, some Middle East and USA (majority to Asia and USA), so is subject to strict AQIS regulation with regard to food safety.
- Has 2 annual shutdowns, one in September-October for 2-3 weeks, and then one at Easter for 7-10 days. During this period, the cold store may be completely emptied but most often is not, so refrigeration is often left on during this period.

Stationery energy use

- The KPC site has 1 coal fired **boiler** of 8MW, using 100-120 t of black coal per week which is delivered by 3 truck deliveries per week. Saturated steam is produced at 1,000 – 1,200 kPa and there is a steam meter on the boiler with local readout. The boiler is about 20 years old but has a new computer control system, which includes automated blowdown but there is no economiser on the stack. There is a hopper which drops coal down onto a stoker and although the fuel feed process is fully automated, there isn’t currently any measurement of the amount of coal into the boiler. The boiler control operates on steam pressure, so that when steam pressure drops below the set point, the stoker increases in speed to deliver more coal. At the moment the boiler is tuned about once every 12 months, but the site is looking at installing automated boiler control which measures carbon monoxide and oxygen in the stack and uses this to modify the air supply system. At the moment, operators tune the boiler manually, so that if wet coal is entering the boiler, the air vent will be opened up, and if the coal has a lot of fines, then the coal bed height will be reduced. Operators log quality parameters on the water treatment system - water going into the boiler is tested for hardness after is comes out of the onsite water softening plant. The main water supply into the boiler is metered with a local readout. The boiler has VSD's on the FD and ID fans. A secondary air fan for overfire is also installed. The feedwater pumps also have VSD's

- **Diesel** is used on coal if it is very wet, but this only happens very infrequently (once per year)
- **Steam** from the boilers is used for
    - Direct heating of steriliser/hot (97°)and handwash (45 °) water in 2 separate tanks (so no condensate recovery), which accounts for about 75% of steam use (possibly more). Handwash water tank is insulated; steriliser/hot water tank is not. High temperature is required for carcass washing (92 °C) but recent testing has indicated that this temperature could be reduced
    - Direct injected into boiler feedwater tank
    - Small amount is used in the boning room for vacuum packing in Cryovac machinery
    - Rendering plant
        - Direct injected into
            - render vessel
            - blood coagulator
        - Indirect use in
            - disc dryer treating solids out of render vessel
            - heating coils in tallow tanks
            - shallow evaporator pans used for
            - concentrating ox gall
- **Condensate recovery** from
    - Disc dryer which is used to dry solids out of render vessel
    - Batch driers on blood system
- **Boiler feed water** system – condensate is returned to the boiler feedwater tank, which is insulated and is normally at about 90-95 °C (due to direct steam injection). In this tank, it mixes with water coming from the treatment plant.
- For steriliser and handwash water, use potable water from local authority without additional treatment
- **Steam metering** currently installed includes:
    - Steam meter on outlet of the boiler with local readout of kg/hr
- **Heat recovery from**
    - stack gases from batch driers in the blood system, and disc drier which dries the solids out of the render vessel, this

energy is recovered in a heat exchanger and the energy is reused in the steriliser and handwash water tanks

- **Water recycling** includes
    - Hot water from steriliser pots, carcass wash and tripe refiner is collected, goes through a contrasheer, directed into a holding tank , most of it is used on the first tripe wash , then a small portion is directed into another holding tank which is heated with direct steam injection and then used on the contrasheer to control fat buildup
    - Final treated effluent is recycled back for yard and cattle belly washing, garden watering, for hosing gut room floor, for hosing down contrasheer pad, fluidizing paunch contents, for coal ash cooling and for DAF unit (as carrier for dissolved air into unit)
- **Water meters** are currently installed
    - the main water line into 2 large holding tanks and
    - flow coming out of 2 holding tanks into plant
    - water going to houses across the road
    - water going into boiler feedwater tank after water treatment plant
    - meter for cold water going into waste heat evaporator
    - meter on water out of steriliser holding tank
    - meter on water out of hot water tank
    - meter upstream of line to plant, WHE and steriliser and hot water holding tanks
    - Recycle water from final effluent pond

Electrical energy use

- The **electricity** system has transformers with kWh meters (local readout only) only for the feed coming into the plant
- **Refrigeration system** is ammonia based, chillers after kill floor, then chillers and freezers for boning room product. Some product is sent to cold stores in Brisbane due to insufficient capacity in onsite system (but do not have operational control), which may then be trucked back to site to make up container loads
- Has a **dry ice** making machine, which is used for packing bulk trimming which are sent to export
- Refrigerant R22 is used for air conditioning in the boning room, 400kg in total
- **Room temperatures**
    - Slaughter floor room temperature is not refrigerated (so is ambient temperature) but has evaporative cooling
    - Boning room temperature is run at 10°C and is run on R22
    - Chillers after slaughter floor are run at 3-7°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 and by the time they reach the chillers they are about 20-22 °C (guess)
    - Loadout is 7°C
    - Cool store (chilled product) is run at about 3 °C
    - The cold store (frozen side) is run at -21 °C
    - A number of blast freezers
    - A number of plate freezers for boxed product, set at -40°C
    - 4 blast tunnels are run at -32°C, 2 for offal and 2 for other products
    - Containers for final product need to be run at -21°C
    - Use refrigerated shipping containers for holding product until have enough to truck offsite
- **Product temperatures & mass estimates**
    - Frozen product is kept at -17°C minimum, percentage of production from boning room converted to frozen product varies depending on customer orders
    - Chilled product is kept at 0°C
    - Offal is chilled or frozen and packed directly into boxes
    - Split between chilled and frozen product depends on customer requirements
- **Variable Speed Drives** are installed
    - Boiler – boiler feedwater pumps (2), FD and ID fans, coal stoker, guillotine door to adjust level of coal bed in boiler
    - Rendering – screw conveyors (3), monopumps on liquid phase (7, 3 on waste heat evaporator, 4 of liquid phase)
    - Water system - 6 on water pumps
    - Another 30 are located throughout the plant
- **Autotransformer starters** – 3 located in engine room
- **soft starters** - tallow/liquid phase separators, disc dryer, and another 10 located throughout the plant
- **star/delta**

Transport energy use

- **LPG** is used for forklifts
- **Unleaded fuel** is used company cars
- **Diesel** is used for onsite transport such 2 tractors

Rendering plant operation

- Low temperature rendering system uses direct steam injection into cone shaped render vessel with MAM which has been reduced in sixe to 12mm and mixed with stick water from tallow processing, fluidized and increased in temperature up to minimum of 85 °C (set point of 90-95 °C, to ensure fat cells are burst and tallow can be recovered) in a continuous process.

Liquid out of vessel goes through centrifuges to separate into solid and liquid streams. Small amount of vapour out of the top of the vessel, goes out a stack out the top of the building.

- Solid phased separated out from flow out of render vessel is fed to a disc dryer which is heated using indirect steam
- Liquid phase off flow out of render vessel is pH corrected by adding Sulfuric acid, and then separated into water and tallow fractions in a centrifuge
- Vapours from the disc dryer and from the eye well batch cookers for the blood drying system go to a waste heat evaporator which is used for evaporating water out of stick water to concentrate the stick water so that it can be recycled back to the solids disc dryer. The water vapour that is evaporated from this system goes through a condenser, and the cooling water that is used in the condenser is recycled back to the handwash and sterilizer holding tanks at about 55 °C.
- Blood coagulator is direct steam injected, then goes through a decanter to separate out the solid and liquid phases, solid phase goes into batch driers which are indirect steam heated. Liquid is directed to wastewater. Target temperatures in the blood coagulators is about 90 °C, as the blood gets older the required temperature decreases.
- indirect use in steam heating coils in the tallow tanks (**not insulated,** condensate not recovered **due to potential for leak causing major boiler problems)**, shallow evaporator pans which is used for concentrating ox gall (batch process)

Wastewater treatment

- wastewater from the slaughter floor and chillers is put through a wedge wire screen, then pumped into Anaerobic pond 1
- Wastewater from the boning rooms, chillers and rendering (after going through a wedge wire screen) is directed into a sump, then pumped to the saveall
- Wastewater from the gut pit and offal room is put through a contrasheer then directed into the Saveall.
- Water from the Saveall is directed into Anaerobic ponds 5 (about ¾ of the flow) and 3 (about ¼ of the flow). Wastewater from the yards tie into the outlet flow from the saveall.
- Quality readings coming out of the Saveall are currently quite high (over 9000 mg/L COD), wastewater quality from the slaughter floor are is of a better quality (3,400 mg/L COD)
- Paunch water is put through a wedge wire screen then directed into anaerobic pond 1
- Anaerobic pond 1 flows into anaerobic pond 2 and then into Facultative pond 4

- Anaerobic pond 3 also flows into facultative pond 4, as does anaerobic pond 5
- Facultative anaerobic pond 4 is pumped to Lake Peter storage dam
- water from carcass wash and sterilizer pots is reused in tripe wash. Water from chillers is defrost water and a bit of hose down, so contains a bit of fat
- treated wastewater is recycled from the final storage dams to the yards, gut pit, boiler and DAF

Current & Future plans

Construction is currently underway on new chillers and a new boning room, which will replace the existing boning room and will allow for a more efficient flow of product from slaughter floor into chillers and then into the boning room. Wastewater from the chillers will be directed into the existing contrasheer.

Operation of the Saveall is currently under review, as once the new plant is operational a new, larger Saveall may be required. KPC are considering building a new dam to hold treated water which will be recycled for yard washing, ash cooling for the boiler, paunch content fluidizing, DAF unit at the Saveall, garden watering, and some hosing in areas with lower quality requirements, such as the gut pit and contrasheer.

Plans are in place to install additional VSD on 2 monopumps in the rendering plant.

2. Results

2.1 Energy usage and Greenhouse emissions at the KPC plant

Table 3 provides a summary of the results for the KPC plant. Approximately 31% of the energy used onsite is electricity, while the majority is used as boiler fuel.

In terms of greenhouse emissions, the total emissions from the site include direct onsite emissions (such as boiler fuel 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 above 25,000 t CO_{2-e} and about 35% were due to emissions from the wastewater treatment system.

Table 3: Energy Use and Greenhouse Emissions Summary

	2007-2008
Total site energy use (TJ)	180
Electricity % of total site energy	31
Boiler fuel % of total site energy	69
Production t HSCW	56,132
Total tCO_{2-e} emissions	42,682
Direct (scope 1) tCO_{2-e} emissions	28,551
% of direct emissions from wastewater	35

Table 4 provides some indications of how the KPC plant compares to industry averages. All key performance indicators were below industry averages, but it is important to keep in mind that KPC currently uses offsite refrigerated storage to manage the overflow that can not be fitted into the existing refrigeration system.

Table 4: Key Performance Indicators compared to Industry averages

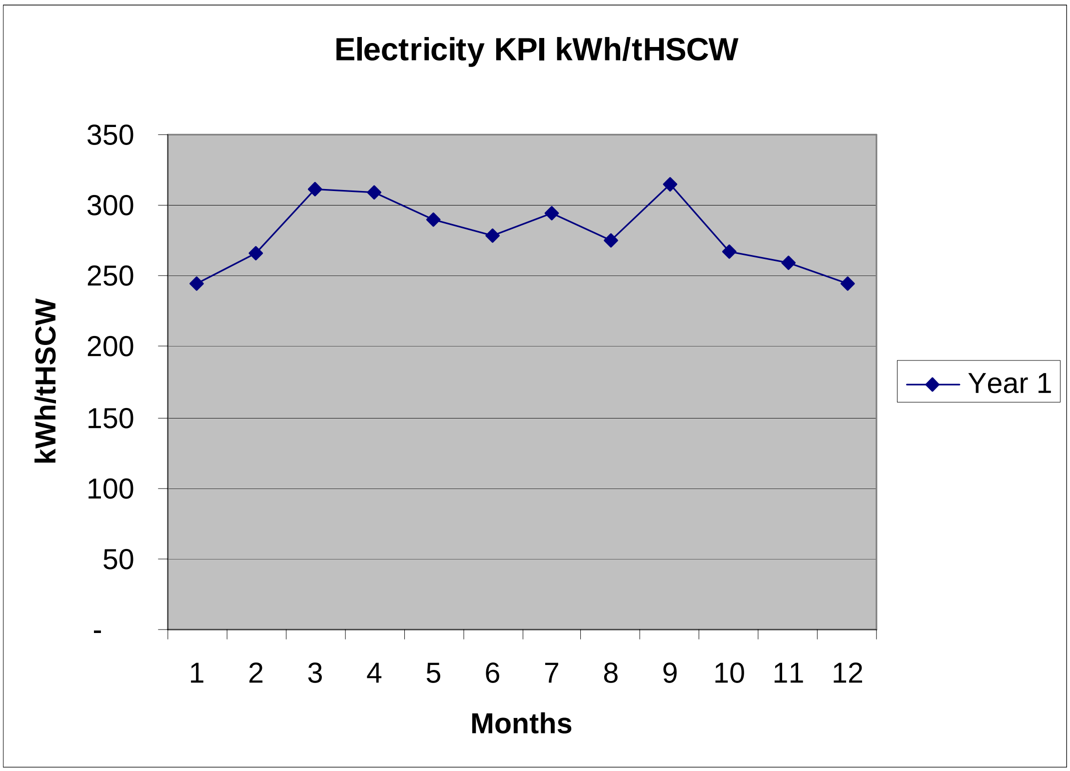
	2007-2008	Industry
Electricity kWh/tHSCW	280	300*
Total energy MJ/tHSCW	3,255	3,389+
Greenhouse kg CO2-e/tHSCW	453	525+

* MLA Environmental Best Practice Guidelines for the Red Meat Processing Industry,
+ MLA Industry environmental performance review, April 2005

2.2 Seasonal variation in energy use

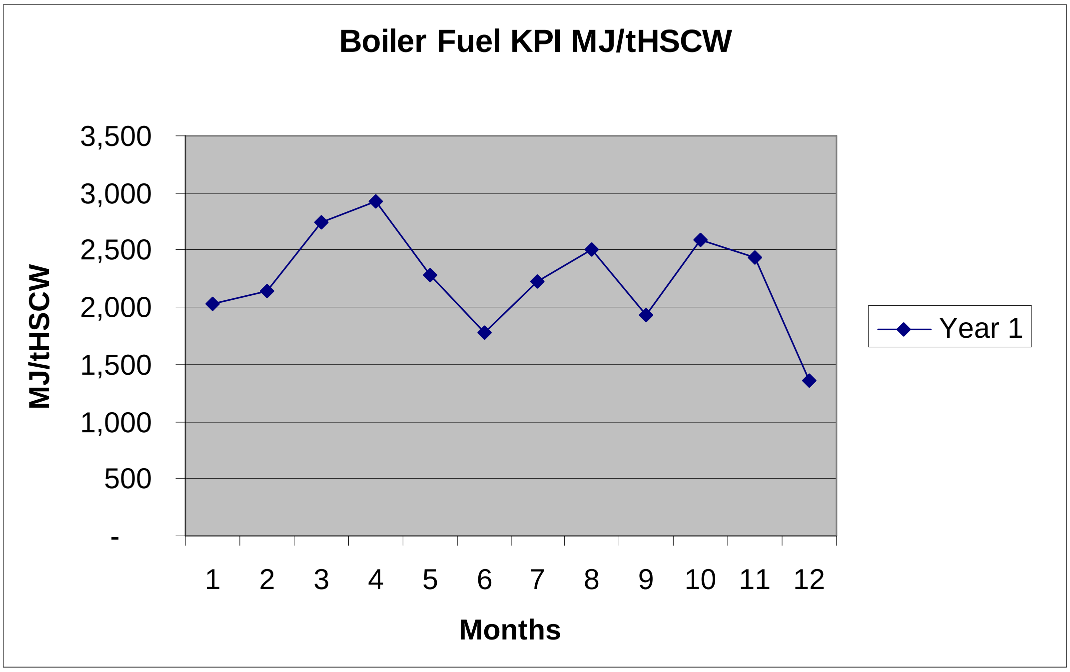
There is a certain amount of **seasonal variation** in consumption even when shutdown impacts are accounted for (months 3/4 & 9) – as seen in Figure 1, electricity consumption increases during summer months (months 5 (November) through to 8 (February), which is consistent with hotter and more humid temperatures putting a greater load on the refrigeration system.

Figure 1: Electricity KPI



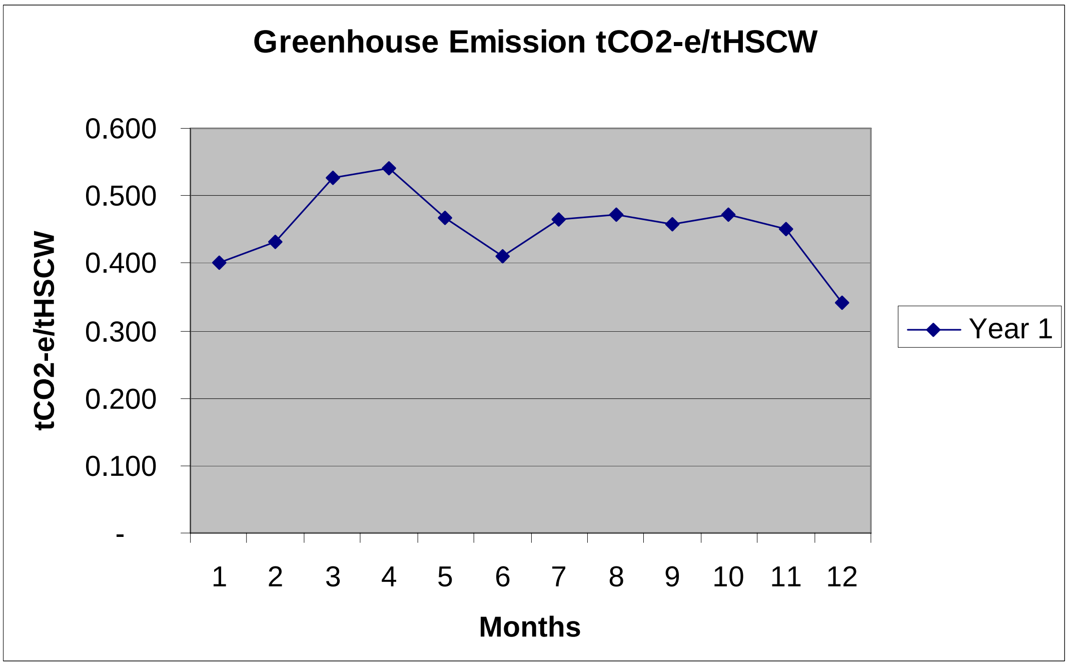
Boiler fuel usage is a little more difficult as the data is based on truck deliveries of coal rather than actual fuel use. It would be expected that winter KPI's would be higher, which is consistent with higher losses from the system and incoming water being at a lower temperature and therefore requiring more energy to be converted to steam. The lower emissions for month 12 (June 2008) may be due to timing of truck deliveries.

Figure 2: Boiler Fuel KPI



Overall, the greenhouse emissions KPI was relatively constant throughout the year.

Figure 3: Greenhouse emissions KPI



2.3 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 1 is consistent with the method which has been used as part of the Greenhouse Challenge Plus Program. 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.

The methods were compared, and due to the above factor, Method 1 provided the most consistent, accurate method for estimating wastewater emissions at the present point in time. However, it is worthwhile KPC investigating whether more detailed site data would provide a more accurate method for estimating wastewater emissions.

2.4 Coal price sensitivity

At present, KPC is paying about $54 per tonne of coal, which equates to about $2 per GJ. During 2008, coking coal has sold to the export market for spot prices over $300 per tonne in Queensland, which equates to about $11 per GJ. Natural gas is normally available at about $8-10 per GJ, depending on load factor.

Each tonne of coal generates 2.387 t $CO_{2\text{-}e}$ when burnt, so if a carbon price of $40per t$CO_{2\text{-}e}$ were factored in, this could increase the cost of coal by $95.48 to $149.48 per tonne, or about $6 per GJ.

2.5 Future trends

These results represent a snap shot of the KPC site 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 KPC.

Table 5: 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 about $40/ t$CO_{2-e}$	Likely to increase price of electricity	Increases pressure to reduce usage	No

2.6 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	2.37 $tCO_{2\text{-}e}$ saving per tonne of coal replaced with 2.2t of biomass, 1.7t of dry wood or 2.6t of wet (green) wood. 100% replacement would require for 2007-2008 consumption (4,602 t coal) would require 10,124 t biomass, 7,823 t dry wood or 11,965 t wet wood. **Short rotation coppicing** yields about 5-30 dry tonnes per hectare per year depending on planting and harvesting cycles, so this would equate to **782 – 1,565** hectares of dedicated plantation.
• **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, which is about 3,846 m3/day of methane per day, which is equivalent to about 3 t coal per day (plant currently uses about 14t per day or 21%). Using biogas in a cogeneration unit could generate about 5,844 kWh per day, currently use about 42,545 kWh per day or 14%)
• **Biodigester** o May be able to take paunch, manure, wastewater o may be eligible for various grants	Manure and paunch are not currently treated onsite, so are not generating emissions. Would allow wastewater emissions to be captured and could offset fuel consumption for thermal uses

Risk management strategy	Potential saving
• **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 o Ergon or Energex may be willing to partner on project due to Qld 18% gas policy	Current peak electrical capacity is 2.4MW, with average of 1.9MW (based on Apr08 bill), boiler installed capacity 8MW. Heat to power ratio therefore about 3.3 at peak, 4.2 during non-peak, and low pressure steam required, so recip engines may be best technical fit
• **Solar preheating** of hot water system o May be grant available	From Eco-efficiency manual, 12 year payback for coal, 2 year payback for natural gas
2. Use more efficient technology	
2.1 Thermal Energy Generation systems	
Optimise efficiency of thermal energy plant by • automating boiler blowdown • insulating tanks and pipework • installing economiser to recovery energy from boiler stack gases • maximise condensate recovery • 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 • maintaining steam traps to prevent steam leaks/losses • removed dead legs/redundant piping	Refer to Appendix 1

Risk management strategy	Potential saving
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: • Increasing condensate recovery by changing from direct to indirect steam use • 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	
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 • Recover tallow and fats from rendering plant waste 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

Risk management strategy 5. Offsets	Potential saving
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
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:

Queensland Government	
• EcoBiz (EPA)	Funds innovation, click here for more details
• Smart Energy Saving Fund	Not eligible if part of EEO program, click here for more details
• Sustainable Energy Innovation Fund (QSEIF) (EPA)	Rounds twice per year, click here for more details
• other	General info on Qld Gov grants available from here eg AJBush at Beaudesert obtained $100K for Qld Gov and $715K from DAFF (Federal)
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 efficiency projects such as

    - Remove steam injection from hot water storage tank, replace with steam heat exchanger on outlet of tank after pump
    - Insulation of hot water storage tank
    - Optimisation of pond system to allow for biogas capture and use in coal fired boiler or new, smaller gas fired boiler
    - Cogeneration using biogas capture from anaerobic wastewater treatment ponds or natural gas

3. Investigate options for mitigating risk of climate change, as outlined on section 2.6

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)	