Econoliser Adoption Guidance Tool – User Guide

# Background

Abattoirs must meet various requirements listed in the Australian Standard (AS 4696:2023) for the “Hygienic production and transportation of meat and meat products for human consumption”. These requirements include:

20.5 The facilities for cleaning and sanitising implements:

c) are provided with an adequate supply of hot potable water at no less than 82°C or an equivalent method of sanitising.

This requirement has commonly been achieved through use of continuous flow 82°C hot water knife immersion sterilisers, which we simply call “sterilisers”. Due to the design, sterilisers use a large amount of water, likely anywhere between 2 and 7 L/min per unit.

An alternative to the traditional steriliser, the Econoliser, has been developed by Airtech (Dublin, UK) and is being utilised in abattoirs around Europe. This Econoliser unit can hold two knives and is usually operated with the two-knife system. That is, one knife is inserted into the unit, which is activated by a press on the knife handle, while the other knife is removed and used. The Econoliser uses only 140 ml per activation when the default 4.5 second spray time is used. This allows either one or both knives to be sterilised at the same time. The spray time can be altered to suit different line speeds, with corresponding changes in water usage.

The AMPC Strategic Plan 2020-2025 identified reduction in water use as a strategic objective through use of efficient practices and technologies. Consequently, while previous versions of the Econoliser units had been tried in Australia, and one remote Australian abattoir operates with only Econoliser units, there was interest in validating the current, all-electric version of the Econoliser in the Australian context for both beef and sheep. Consequently, in February 2023, an AMPC funded trial, undertaken at two beef and one sheep abattoirs, validated that the Econoliser can achieve an equivalent microbiological and physical cleanliness outcome as the steriliser.

Therefore, the *Econoliser Adoption Guidance Tool* was developed to assist abattoirs to compare their steriliser use with the Econoliser in terms of water usage, energy usage, and total emissions (reported as “tonnes CO2-equivalent” or t CO2-eq), so that they can make better informed decisions as to the potential benefits the Econoliser may offer them. Note that the tool has been prepared for **knife sterilisers** only (i.e. not air knives, hock cutters, splitting saw, etc. for which equivalent units may be available from Airtech) as these contribute a large proportion of the water use in an abattoir.

This document aims to provide guidance to users on how to complete each of the questions in the Excel-based *Econoliser Adoption Guidance Tool*. In addition, we provide information about data validation, any assumptions made and calculation details – this information is identified using a light blue background. The various inputs and outputs are discussed in the sections below. At the end of this document are provided several examples to illustrate the application of the tool.

For the emissions related calculations, including energy contents of various combustion sources, see the document entitled "Fuel combustion of National Greenhouse and Energy Reporting (Measurement) Determination 2008" (NGERMD), which is available from the Clean Energy Regulator’s (CER) website.[[1]](#footnote-1)

# General Comments

Abattoirs considering adoption of the Econoliser are advised to discuss their situation (including chain speed) and adoption plan directly with Airtech Distribution Ltd., who have considerable practical experience in successfully installing these units in various abattoirs in Europe.

For example, for some dirty operations, e.g. Y-cut which often results in wool remnants on the knife, Airtech recommends that knives are rinsed of visible detritus (e.g. wool) prior to insertion into the Econoliser (Note: the associated water use has not been included in this tool). On fast moving lines, the spray time used by the Econoliser may need to be reduced, e.g. from 4.5 s to 4 s or less, which was done at one station during the trial, without any negative effects on microbiology of knives. Such a change also needs to be reflected in the reduced water use of the Econoliser (see calculation of Input I-5). In addition, fast moving lines require the Econoliser to heat water rapidly, which may not be achievable if the input water temperature is too cold (e.g. less than approximately 40°C), limiting the savings that may be achievable.

A critical requirement for the operation of the Econoliser is that water pressure delivered to the Econoliser is at least 35 PSI. While many abattoirs have adequate pressure (e.g. 7 bar = 101 PSI) at the pump, this pressure drops throughout the plant as sterilisers and hand wash basins reduce this pressure. For this purpose, Airtech can supply a pressure manifold which can easily be swapped for the standard spray nozzles and measures the pressure of the water supply. In addition, guidance from Airtech to abattoirs interested in plant wide adoption of the Econoliser is to start replacing sterilisers with Econolisers closest to the pump first and work down the line (over time). This approach delivers the highest pressure to the installed Econoliser(s) and helps maintain pressure down the line.

# Inputs

Input cells are identified in the Excel tool by an orange shaded background and dark blue text. Where possible, data validation rules have been implemented to ensure sensible input values.

In the first instance, it is suggested that you include all your steriliser units in the tool, which will provide you with information about their water use, energy consumption and total emissions. After that, you can modify the inputs to investigate different scenarios, similar to those in the case studies, e.g. the effects of replacing a low usage steriliser, e.g. at carton meat inspection, with an Econoliser.

1. Plant Location

This input is provided as a drop-down box from which you can select the state/territory of your abattoir; no other options are possible (i.e. abattoirs outside of Australia). The answer is used to lookup the emissions factors from those listed in “Part 6—Indirect (scope 2) emission factors from consumption of electricity purchased or lost from grid” of NGERMD. This emissions factor (t CO2‑eq) relates only to electricity consumption from the grid and does not include other forms of electricity generation (on plant).

**For Steriliser**: Not used.

**For Econoliser**: Used with the amount of electricity used by the Econoliser, based on amount of water that is heated and by how much. If warm or hot water are used as input to the Econoliser, only the increase in temperature that needs to be achieved is affected (see 0 and 0).

1. Number of SF units

Enter the number of steriliser units that are installed and used on the slaughter floor (SF). Include sterilisers in other areas, e.g. offal room, provided they are used approximately once per carcase. We suggest you use the “Steriliser Audit” tab and complete the information in the top table for the slaughter floor.

Data validation requires the input to be a whole number (integer) between 0 and 100 (units).

**For Steriliser**: We use this number, together with other units (see I-3), and the flow rate to calculate the water usage. For this calculation, it does not matter whether a steriliser is used more than once per carcase, as the rate of water flow will be independent of how often operators dip their knives in the sterilisers.

**For Econoliser**: We assume the Econoliser is used once, and only once, per carcase, i.e. the Econoliser is activated only once per carcase. For example, in an abattoir that kills on average 1000 animals per day, each Econoliser unit would be activated 1000 times.

For some operations this may not be correct, e.g. some operations may require the knife to be dipped (and changed) multiple times per carcase. However, for the purpose of this tool, it was decided that such operations are relatively infrequent (e.g. 1 or 2 out of 50 stations on the slaughter floor) and hence the underestimation will be relatively small and of little practical importance.

1. Number of BR (and other) units

Enter the number of steriliser units you have installed in the boning room (BR) and in other locations, where they are potentially used infrequently. Such units may include the pre-trim stand(s) into the boning room, Carton Meat Assessment, load out areas, etc. The difference between these and SF units is that for the SF units, the number of Econoliser activations is based on the average daily kill, while for BR (and other) units, the number of Econoliser activations is based on additional user information. We suggest you use the “Steriliser Audit” tab and complete the information in the bottom table for the boning room and other areas.

Data validation requires the input to be a whole number (integer) between 0 and 100 (units).

**For Steriliser**: We use this number, together with SF units (see I-2) and the flow rate to calculate the water usage. For this calculation, it does not matter whether a steriliser is used more than once per carcase (e.g. per side), as the rate of water flow will be independent of how often operators dip their knives in the sterilisers.

**For Econoliser**: We assume that these units are used relatively infrequently, and hence we need an estimate of how often, on average, they are used, which is specified by I-8.

Note that some of these sterilisers may be used quite frequently, for example, at the BR pre-trim, the operator may sterilise the knife after each carcase side, for regulatory or fat-removal purposes, while at the entry to the boning room, staff with knives may sterilise their knives after each break. On the other hand, other sterilisers may get used very infrequently, such as those at the carton meat assessment (CMA) or in the load-out area. Both cases are OK and all these sterilisers, and the frequency with which they are used should be included here.

1. Average flow rate (Sterilisers only)

The flow rate (litres per minute) of sterilisers is important for calculating the daily and annual water usage associated with sterilisers. We understand that each steriliser may have a slightly different flow rate and if you have measured this, e.g. using a clip-on flow meter, then you can capture this information in the two tables of the “Steriliser Audit” tab. The input into this cell should be based on the “Combined average flow rate” cell, which can be found below the bottom table; this cell combines the average flow rates of slaughter floor sterilisers (top table) and boning room and other sterilisers (bottom table).

Data validation requires the input to be a number between 0.1 and 15 (litres per minute).

**For Steriliser**: Used together with the number of sterilisers to calculate the daily water usage.

**For Econoliser**: Not used.

1. Water use per cycle (Econoliser)

To calculate the water used by the Econoliser, we need to know the amount of water used per cycle. The default value of 140 ml (= 0.14 L) is appropriate for the factory-set cycle time of 4.5 s, provided the water pressure is the required 35 PSI. Unless you change most or all Econoliser units, we suggest you leave this value unchanged.

Data validation requires the input to be a number between 0.08 and 0.2 (litres).

**For Steriliser**: Not used.

**For Econoliser**: Used together with the number of carcases processed daily and the number of activations of non-slaughter floor sterilisers to calculate the water usage.

Airtech have specified that the default spray nozzles in the Econoliser provide 15 ml of water per second, i.e. 15×(2 nozzles)×4.5s = 135 ml per activation, which was rounded up to 140 ml based on Airtech’s experience.

1. Average daily operating duration

The time the sterilisers are flowing affects how much water they use. You should input the relevant time (in hours) here, from the start of the day when sterilisers are turned on to the end of the day when they are turned off. If sterilisers are consistently turned off during breaks, then you should exclude break times from this input. However, if sterilisers are left to flow during breaks, then break durations should be included.

We assume that the operating duration per day is the same on each day, on average. This can accommodate various scenarios and only the average duration is important.

Example: Consider a plant that operates 38 weeks of the year 5 days per week, 10 hours each day, and for 12 weeks this plant operates an additional Saturday morning shift (5 hours); the plant is shut down for maintenance for two weeks. The total number of hours this plant operates is:

 (50 weeks) × (5 days per week) × (10 hours per day) +
 (12 weeks) × (1 Saturday per week) × (5 hours per day) = 2560 hours
which are worked over
 (50 weeks) × (5 days per week) + (12 weeks) × (1 days per week) = 262 days
giving an average operating time per day as 2560 / 262 = 9.8

Data validation requires the input to be a number between 1 and 24 (hours).

**For Steriliser**: Used to calculate the daily water consumption.

**For Econoliser**: Not used.

1. Average daily kill (SF)

Enter the average number of animals slaughtered per day. Ideally use the average number calculated over a whole year, but you can use shorter durations, e.g. 3 or 6 months.

Data validation requires the input to be a whole number (integer) between 1 and 15,000 (animals).

**For Steriliser**: Not used.

**For Econoliser**: Used as the estimated number of activations per unit per day to calculate water consumption.

1. Average daily number of times knives are sterilised per unit (in BR & other)

This is possibly the trickiest input in the tool. What we are interested in is the number each non-slaughter floor unit is used daily. Recall from the discussion of inputs I-2, I-3 and I-7 that we assume that slaughter floor units are used once per carcase. So, for the non-slaughter floor units, we need to know how often they are used, on average, to calculate the appropriate outputs. We suggest that you complete the bottom table (related to the boning room and other areas) of the “Steriliser Audit” tab. In this table, you can specify the number of units at each station (most will probably be 1) and how often you estimate the unit would be used.

Data validation requires the input to be a number between 1 and 10,000 (times per unit). Note that in most cases, it would be reasonable for the input to be less than the average daily kill. However, for some scenarios, this may not hold, e.g. if we wanted to evaluate the boning room pre-trim only, when knives are sterilised after each **carcase side**, and hence the input would be twice the daily kill.

**For Steriliser**: Not used.

**For Econoliser**: Used as the estimated number of activations per unit per day to calculate water consumption.

1. Number of operating days per year

The number of days that an abattoir operates is important for calculating the annual water consumption. We assume that the slaughter floor and boning room (and other areas) are operational the same number of days, i.e. abattoirs do not have a Saturday boning-only shift.

Data validation requires the input to be a whole number (integer) between 1 and 365 (days).

**For Steriliser**: Used to calculate annual water usage from daily water usage.

**For Econoliser**: Used to calculate annual water usage from daily water usage. Also used to calculate the annual energy usage for the Econoliser, taking into account the inlet water temperature to the Econoliser. That is, if warm or hot water is used, then the corresponding portion is based on heating of water through the selected combustion source.

1. Water cost

Input the cost ($ per kL) of purchasing and disposing water. If the amount of water purchased and disposed are approximately the same, then you can simply add their corresponding costs together. However, if these two amounts differ substantially, then you should calculate this input as follows:

[ (Cost to purchase water; $/kL) × (Amount purchased; kL) +

(Cost to dispose water; $/kL) × (Amount disposed; kL) ] / (Amount purchased; kL)

Data validation requires the input to be a number between 0 and 20 ($ per kL).

**For Steriliser**: Used to calculate the annual water cost.

**For Econoliser**: Used to calculate the annual water cost.

1. Electricity cost

You should be able to obtain this input value ($ per kWh) from your Electricity provider, i.e. your electricity bill.

Data validation requires the input to be a number between 0 and 20 ($ per kWh).

**For Steriliser**: Not used.

**For Econoliser**: Used to calculate the annual energy cost to heat water.

1. Combustion source for water heating

This input is provided as a drop-down box from which you can select the (most) appropriate source. The possible values are based on the list of solid, gaseous and liquid sources provided in “Schedule 1—Energy content factors and emission factors” of the NGERMD (you can see them listed in the “Lookup” tab if you are interested).

The answer is used to lookup the energy content of the combustion source as well as the emissions factors.

**For Steriliser**: Used to look up the emissions factors that have been listed for the selected combustion source and to calculate the amount of combustion source and energy required to heat water.

**For Econoliser**: Only used if the inlet water temperature of the Econoliser is different from the incoming water temperature to the plant, i.e. water has been (partially) heated by the plant using the combustion source selected.

1. *Energy content factor of combustion source*

This cell is shown using light grey text – you do not need to specify this value as it is looked up from the combustion source you have selected (I-12).

**For Steriliser**: Used to calculate the amount of the combustion source required to meet the annual energy requirements to heat the water for the sterilisers.

**For Econoliser**: Only used if the inlet water temperature of the Econoliser is different from the incoming water temperature to the plant, i.e. water has been (partially) heated by the plant using the combustion source selected.

1. Cost to heat water (using plant's source above)

**Important!** This input value needs to be provided in the units of “$ per kWh” to complete to calculations. However, in preparing the tool, we have found that this value may not be available in these units. For this reason, an additional calculator has been included on the right in cells Q1:R6 entitled “Cost of heating water (optional)” – this should help you to make the appropriate conversion as follows:



* Make sure you have the correct combustion source selected (Input I-12).

Enter the number of units of this combustion source that you have purchased in the last 12 months (though you can use a shorter or longer time if you like) into cell Q2. Note that the units should be either m3 (for gaseous fuels), tonnes for solid fuels, or tonnes or kL for liquid fuels – see the units of energy for your combustion source in cell D14 – which will list GJ/m3, GJ/kL or GJ/t – for the appropriate units to use here.

* Enter what you paid for this amount of fuel into cell Q3 in $.
* Cell Q4 calculates the amount of energy in GJ that is provided by the amount of fuel you have purchased. *Note: If your combustion source bill specifies the amount of fuel used in “GJ” rather than “GJ/m3”, say, then you can overwrite this cell with the appropriate GJ value.*
* Cell Q5 converts the value in Q4 from GJ to kWh using a conversion factor of 0.0036 GJ per kWh.
* Cell Q6 then calculates the unit cost of your combustion source as $ per kWh.

The calculated value from Q6 is automatically used as the input here (cell C15), which is why this cell’s text colour is light blue. If you don’t need to use the side calculations, then you can simply input your value in this cell (C15) and overwrite the existing formula.

Data validation requires the input to be a number between 0 and 20 ($ per kWh).

**For Steriliser**: Used to calculate the annual energy cost to heat water.

**For Econoliser**: Not used.

1. Average incoming water temperature into plant

We understand that water coming into the plant may differ slightly in temperature throughout the year. However, these differences are likely to have a relatively small effect when calculating how much energy is required to heat the cold incoming water to above 82°C, which is why only the average water temperature is needed here. Either measure the water temperature of your plant supply, if possible, or make a best guess estimate – we provide a value of 15°C as a reasonable default.

Data validation requires the input to be a number between 0 and 50 (°C).

**For Steriliser**: Used to calculate the annual energy needed to heat water.

**For Econoliser**: Used to compare with the water temperature fed into the Econoliser (I-18). If the two are the same, then this value is ignored. If the two values are different, then this value is used to calculate how much energy is used to heat the water, using the selected combustion source, to the Econoliser inlet temperature.

1. Water temperature outgoing from heating source

The water temperature from your heat source, e.g. boiler, will usually be higher than the 82°C needed at the steriliser to allow for heat loss throughout the pipe work. Insert the temperature of the water that exits your heat source.

Data validation requires the input to be a number between 80 and 100 (°C).

**For Steriliser**: Used to calculate the energy needed to heat water.

**For Econoliser**: Not used.

1. System heat retention efficiency

The temperature of the hot water supply drops throughout the pipe work in the plant. You will need some engineering input as to what the most appropriate value is – we have picked a default value of 70% which is based on feedback by Airtech. Note that this is not only the efficiency of your boiler, which will be much higher.

Data validation requires the input to be a number between 1 and 100 (%).

**For Steriliser**: Used to adjust the “base” energy required to heat water to account for the loss of heat in the system.

**For Econoliser**: Only used if the inlet water temperature of the Econoliser is different from the incoming water temperature to the plant, i.e. water has been (partially) heated by the plant using the combustion source selected.

1. Water inlet temperature for Econoliser

The temperature of the water supply used for the Econoliser affects how much energy the Econoliser uses to raise the temperature to the temperature specified in Input I-19. For many plants, the “best” scenario (in terms of costs, energy and emissions) is when the Econoliser is connected to the cold-water supply and the Econoliser heats the water as needed, though this does depend on the combustion source. **However, it must be noted that the Econoliser will take longer to heat cold water (e.g. 10°C) than warm water and as such warm water (approx. 40°C) is recommended by the manufacturer for most chain speeds**. In addition, it may be easier to connect the Econoliser to the warm or hot water supply to achieve the necessary pressure, though this will affect energy and carbon emissions, which are indirectly involved and not related to the Econoliser use *per se*.

Data validation requires the input to be a number between the incoming water temperature to the plant (I-15) and 85 (°C).

**For Steriliser**: Not used.

**For Econoliser**: Used to calculate the energy usage of the Econoliser, as well as the energy needed to heat the water to this temperature using the traditional combustion source.

1. Water temperature (Econoliser)

The Econoliser typically heats water to around 94°C to allow for some cooling during the spray so that the water hitting the knife blade is at least 82°C. We have selected a default of 94°C to reflect factory settings and this should not be changed unless you have made changes to the unit.

Data validation requires the input to be a number between 80 and 100 (°C).

**For Steriliser**: Not used.

**For Econoliser**: Used to calculate the energy needed to heat water from the inlet water temperature to this temperature.

# Outputs

The following outputs are provided by the tool. The outputs listed in italic font and light grey text in the tool are for intermediary steps or for interest only and provided for transparency. The main outputs in the tool are shown on a blue shaded background with bold font in the tool and using bold heading font here.

1. Daily water usage

The amount of water used (in kL) by all your sterilisers on the slaughter floor, boning room and other areas, on a daily basis. Compared with this value is the corresponding value if all knife sterilisers were replaced by Econoliser units.

**For Steriliser**: Calculated as the total number of sterilisers used in the plant, multiplied by the number of operating minutes (converted from hours) and the flow rate; the result is converted to kL. The formula is:

 ( I-2 + I-3 ) × I-4 × ( I-6 × 60 ) / 1000

**For Econoliser**: Calculated as the (total number of sterilisers on the slaughter floor multiplied by the number of animals killed per day) plus (total number of BR and other sterilisers multiplied by the average number of activations per day). The result is multiplied by the amount of water per activation and converted to kL. The formula is:

 ( I-2×I-7 + I-3×I-8 ) × I-5 / 1000

1. Annual water usage

The daily water usage is converted to an annual amount based on the number of operating days. For both the steriliser and the Econoliser, the value from O-1 is multiplied by the number of operating days I-9.

1. **Annual cost of water**

The annual cost of water (in $) is calculated by multiplying the annual water usage by the cost of water. For both the steriliser and the Econoliser, the value from O-2 is multiplied by the cost of water (I-10).

1. Annual energy needed to heat water (Hot water)

This output relates to the amount of energy needed to heat water using the combustion source selected by you as input I-12. The calculation takes into account the amount of heating required, the system efficiency and then converts the result to GJ. Note that we are assuming that all the water used and heated is cold water, rather than re-using warm water which requires less energy.

**For Steriliser**: Calculated as the annual amount of water used multiplied by the difference in incoming and outgoing water temperature, which is divided by the system efficiency to account for loss in the system and then converts the result to GJ using a constant specific heat of water of 4190 J/kg K. The formula is:

 O-2 × [ (I-16 - I-15) / I-17 ] × 4190 / 1,000,000

**For Econoliser**: Calculated as for the steriliser with the difference that the water is only heated to the water temperature feeding the Econoliser. The formula is:

 O-2 × [ (I-18 - I-15) / I-17 ] × 4190 / 1,000,000

1. Annual energy needed to heat water (Econoliser)

This output relates specifically to the Econoliser and is based on whether the unit is connected to the cold, warm or hot water supply in the plant. That is, we calculate how much energy is needed to raise the water temperature from the Econoliser supply to the operating temperature. The result is converted to GJ.

**For Steriliser**: Not used.

**For Econoliser**: Calculated as the amount of water used multiplied by the difference in incoming and final water temperature of the Econoliser. No adjustment for efficiency is needed in this case due to the short supply from the heating element to the nozzles. The result is converted to GJ using a constant specific heat of water of 4190 J/kg K. The formula is:

O-2 × (I-19 - I-18) × 4190 / 1,000,000

1. Annual energy needed to heat water (Combined)

This is the combined annual energy needed to heat water. For the sterilisers, this result is the same as for O-4 and for the Econoliser, it is the sum of energy needed to heat water to the supply temperature using the combustion source (O-4) and the energy needed for the Econoliser to heat the water to operating temperature (O-5).

1. *Annual energy needed to heat water (unit change) – Hot water, Econoliser and Combined*

These are intermediary outputs used to display the change in units from GJ to kWh for the previous three outputs (O-4, O-5, and O-6). In all cases, the conversion is done by multiplying the corresponding output (in GJ) by 0.0036 (kWh/GJ).

1. **Annual energy cost to heat water**

This output is calculated based on the amount of energy required, using the relevant amounts for water heating using combustion sources and Econoliser (calculated in O-7), and the corresponding cost per unit energy.

**For Steriliser**: Calculated as the amount of energy required multiplied by the cost to heat water based on the selected combustion source. The formula is:

 O-7 × I-14

**For Econoliser**: Calculated as the combined costs for (a) the amount of energy required multiplied by the cost to heat water based on the selected combustion source and (b) the amount of energy required multiplied by the cost of electricity purchased from the grid. The formula is:

 ( O-7Hot water × I-14 ) + ( O-7Econoliser × I-11 )

1. Amount of combustion source needed to heat water supply

This is the amount of combustion source needed to deliver the required energy to heat the water.

**For Steriliser**: Calculated as the amount of energy needed divided by the energy content per unit combustion source. The formula is:

 O-4 / I-13

**For Econoliser**: Only used when the supply water temperature for the Econoliser is warmer than the plant supply. Calculated as the amount of energy needed to bring water to the Econoliser supply water temperature (I-18) divided by the energy content per unit combustion source. The formula is:

 O-4 / I-13

1. *CO2, CH4, N2O and Total emission factors*

These values are looked up from the information provided in “Schedule 1—Energy content factors and emission factors” of the NGERMD, which are listed in the “Lookup” Tab.

**For Steriliser**: Looked up using the Excel’s vlookup function. The total emission factor is calculated as the sum of the CO2, CH4 and N2O factors, which are expressed on a CO2 equivalent basis.

**For Econoliser**: Not used.

1. Emission Factor (based on location) for grid electricity

These values are looked up based on the plant location (I-1) from the information provided in “Schedule 1—Energy content factors and emission factors” of the NGERMD, which are listed in the “Lookup” Tab.

**For Steriliser**: Not used.

**For Econoliser**: Looked up using the Excel’s vlookup function.

1. Total emissions (Econoliser only)

Total emissions calculated for the Econoliser only based on the electricity consumption, excluding emissions related to the heating of water using a combustion source for supply of warm or hot water to the Econoliser.

**For Steriliser**: Not used.

**For Econoliser**: Calculated as the total energy used by the Econoliser only multiplied by the Emissions factor for the electricity drawn from the grid. The result is converted to t CO2-eq. The formula is:

 O-7Econoliser × O-11/ 1000

1. **Total emissions**

Total emissions are calculated from the amount of energy used based on the combustion source (and electricity) and the emissions factors.

**For Steriliser**: Calculated as the product of the energy generated using the combustion source selected multiplied by the total emissions factor and converted to t CO2-eq. The formula is:

 O-4 × O-10 / 1000

**For Econoliser**: Calculated as the total emissions from the combustion source (if warm or hot water is supplied to the Econoliser) and the grid-related electricity emissions. Emissions related to the combustion source are calculated as for the steriliser. The formula is:

 O-4 × O-10 / 1000 + O-12

# Examples

In Table 1 are listed the inputs for a representative beef abattoir to illustrate the use of the tool and demonstrate the types of water, energy and emissions savings that are possible. It should be noted that abattoirs interested in the Econoliser should use the tool with their specific inputs to get a better understanding of the potential benefits.

Table : Inputs to adoption guidance tool for a representative abattoir located in Victoria.

|  |  |
| --- | --- |
| **Input** | **Example** |
| 1. Plant location
 | VIC |
| 1. Number of SF units
 | 50 |
| 1. Number of BR (and other) units
 | 10 |
| 1. Average flow rate (Sterilisers only; L/min)
 | 4 |
| 1. Water use per cycle (Econoliser; L/cycle)
 | 0.14 |
| 1. Average daily operating duration (hr)
 | 9 |
| 1. Average daily kill (SF)
 | 500 |
| 1. Average daily number of times knives are sterilised per unit (in BR & other)
 | 10 |
| 1. Number of operating days per year
 | 250 |
| 1. Water cost ($/kL)
 | 3.75 |
| 1. Electricity cost ($/kWh)
 | 0.16 |
| 1. Combustion source for water heating
 | 17: Natural gas distributed in a pipeline |
| 1. Cost to heat water (using plant's source; $/kWh)
 | 0.20 |
| 1. Average incoming water temperature into plant (°C)
 | 15 |
| 1. Water temperature outgoing from heating source (°C)
 | 95 |
| 1. System efficiency (heat retention/loss; %)
 | 70 |
| 1. Water inlet temperature for Econoliser (°C)
 | 15 |
| 1. Water temperature (Econoliser) (°C)
 | 94 |

Note that for this plant, information was available for the amount of gas used per year and the associated costs. Using these inputs, a cost in $ per kWh was calculated using the additional tool in cells Q2:R6, a screenshot of which is shown below, which calculated a value of 0.20 $/kWh.



In Table 2 is summarised the most important outputs from the adoption guidance tool for the inputs listed in Table 1, comparing the steriliser and Econoliser. These outputs assume 100% adoption of the Econoliser, i.e. replacement of all continuous flow knife sterilisers with Econolisers. From these results, it can be seen that full adoption of the Econoliser can result in substantial reductions of water use and cost, energy use and costs and total emissions.

Table : Outputs from the adoption guidance tool, using the inputs from Table 1.

|  |  |  |
| --- | --- | --- |
| **Outputs** | **Steriliser** | **Econoliser** |
| Daily water usage (kL) | 129.60  | 3.51  |
| Annual water usage (kL) | 32,400  | 879  |
| Annual cost of water ($) | 121,500 | 3,294 |
| Annual energy needed to heat water (GJ)\* | 15,515  | 291  |
| Annual energy cost to heat water ($)\* | 861,943  | 12,960 |
| Total emissions (t CO2-equivalent)\* | 799.5  | 68.9  |

\* The output is for the steriliser versus the Econoliser only as the Econoliser is supplied with cold water in this scenario.

As noted above, different adoption scenarios can be evaluated using the adoption guidance tool. In the following sections, several scenarios are evaluated by changing one or more of the inputs in Table 1 while keeping the remaining unchanged.

## Cold water versus hot water supplied to the Econoliser

In some cases, it may be “easier” to use warm or hot water supply to achieve the required pressure at the Econoliser. This water has to be heated using the traditional combustion source and transported to the Econoliser, thus losing temperature, and thus potentially missing out on the on-demand heating benefit of the Econoliser. This scenario was evaluated by changing the incoming water temperature (Input 17; Table 1) for the Econoliser from 15°C to 82°C. While there is no change to the water consumption and cost, the energy and emission outputs are affected as follows.

* The annual energy needed to heat water increases from 291 GJ to 396 GJ and is comprised of 352 GJ to heat the water using the abattoir’s combustion source (Natural gas) and 44 GJ for the Econoliser to heat the water from 82°C to 94°C.
* The annual energy cost to heat water increases from $12,960 to $21,572.
* However, the total emissions decreased from 68.9 t CO2-eq to 28.8 t CO2-eq, of which 10.6 t CO2-eq were associated with the Econoliser only.

This effect on total emissions seems counterintuitive and this is due to the relatively high emission associated with Victorian power generation (0.85 kg CO2-e/kWh) versus the comparable value obtained from the combustion source (0.186 kg CO2-e/kWh, after conversion from CO2-e/GJ to CO2-e/kWh).

As such, the results are plant location and heating source/cost specific. For example, a plant in South Australia with the same inputs would have a much smaller total emission of 20.3 t CO2-eq under the cold water scenario, and this would increase to 21.3 t CO2-eq under the hot water scenario.

Clearly, any potential benefits must be assessed on an abattoir specific basis.

## Small versus large number of animals processed

Small stock abattoirs process many more animals than large stock and as a result use each steriliser more often (assuming knives are sterilised between carcases). Leaving all other inputs as per Table 1, the effect of changing the Average daily kill (Input 7; Table 1) from 500 to 5,000 and the average daily number of knife dips per boning room (and other) steriliser from 10 to 100 (Input 8; Table 1) was evaluated. The results are summarised in Table 3. Since sterilisers operate on a constant flow rate (assumed to be) independent of slaughter volume, the results for the steriliser are unchanged. In contrast, given the 10-fold increase in slaughter (and boning) volume, the various outputs also increase 10-fold.

Table : Outputs from the adoption guidance tool, using the inputs from Table 1, with an average daily kill of 5,000 animals.

|  |  |  |
| --- | --- | --- |
| **Outputs** | **Steriliser** | **Econoliser** |
| Daily water usage (kL) | 129.60  | 35.14  |
| Annual water usage (kL) | 32,400  | 8,785  |
| Annual cost of water ($) | 121,500 | $32,944 |
| Annual energy needed to heat water (GJ) | 15,515  | 2,908 |
| Annual energy cost to heat water ($) | 861,943  | 129,277 |
| Total emissions (t CO2-equivalent) | 799.5  | 686.8 |

## Low frequency use steriliser

One attraction of the Econoliser is its low water usage which seems particularly suited to situations where a knife does not need to be sterilised often. An example of such an operation is the Carton Meat Assessment where the knife usually only requires sterilising after a defect has been removed, which generally happens infrequently, e.g. 10 times per day. To evaluate this scenario, the number of slaughter floor units is set to zero (Input 2; Table 1) and the number of boning room and other units is set to 1 (Input 3; Table 1), with all other inputs as specified in Table 1. The results for this single steriliser replacement are shown in Table 4.

Table : Outputs from the adoption guidance tool, using the inputs from Table 1, for only a single boning room steriliser compared with the Econoliser.

|  |  |  |
| --- | --- | --- |
| **Outputs** | **Steriliser** | **Econoliser** |
| Daily water usage (kL) | 2.16  | 0.00  |
| Annual water usage (kL) | 540.00  | 0.35  |
| Annual cost of water ($) | 2,025 | 1 |
| Annual energy needed to heat water (GJ) | 259 | 0.12 |
| Annual energy cost to heat water ($) | 14,366 | 41 |
| Total emissions (t CO2-equivalent) | 13.3 | 0.2 |

## Fully customized approach

The tool is flexible enough to be used in a variety of situations and is not limited to abattoirs or as described above. As noted above, the most important distinction between slaughter floor sterilisers and boning room/other sterilisers is that for the slaughter floor, the number of Econoliser equivalent activations is calculated from the daily kill, while for boning room/other sterilisers, the number of activations needs to be estimated.

Consequently, a fully customised approach can be applied for any type of situation, e.g. in an independent boning room or smallgoods processor, provided the establishment has an estimate of the number of steriliser dips per unit – which equals the number of Econoliser activations. For example, a smallgoods processor may have 2 sterilisers, that are used 100 and 10 times per day, on average, respectively. Therefore, this business would set the number of SF units to 0 (I-2), the number of BR units to 2 (I-3) and the number of daily activations (I-8) to (100 + 10)/2 = 55.

1. <https://www.cleanenergyregulator.gov.au/About/Legislation-and-regulations>; version used is Compilation 16, dated 21 September 2023 [↑](#footnote-ref-1)