# Fact Sheet

AUSTRALIAN MEAT INDUSTRY COUNCIL

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# REDUCING ENERGY COSTS FOR MEAT RETAILERS

Based on extensive site appraisal and re-engineering experience, energy experts have identified common opportunities for meat retailers to save on energy costs. Many have energy-intensive systems that were built to a price, based on standard designs little changed for over 40 years.

On top of rapidly increasing energy costs, many refrigeration systems still use ozone-depleting refrigerants that are being phased out, with rapidly-increasing price.

## WHERE IS THE ENERGY USED?

The main areas of energy use at retail butchers are refrigeration, hot water and lighting.

Refrigeration and water heating are ideal candidates for re-engineering: they can often be combined into a system that recovers waste heat from the refrigeration system to reduce heating needs.

The main energy-using components in a refrigeration system are:

- Compressor(s) 40-60%
- Condenser fans 10-20%
- Evaporator fans 10-20%
- Defrost heaters, lights 5-20%

Careless placement of components and poor maintenance can easily drive up the energy costs.

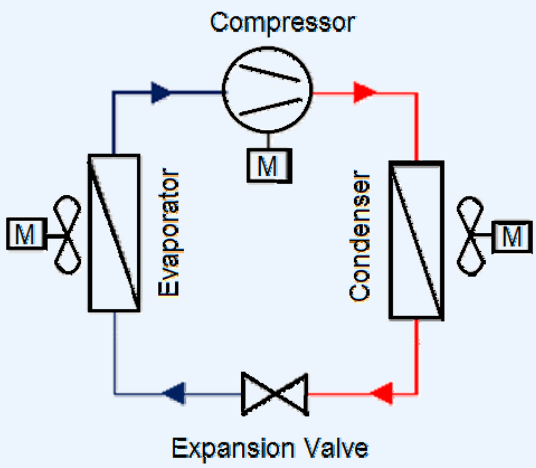


Figure 1 - Main components of a refrigeration system

## EASY ENERGY-SAVING TECHNIQUES

Energy savings can be achieved by a range of simple measures. The three most common methods are:

**1. Optimize condensing unit location** – condensers reject heat to ambient air. They need to be shaded, with plenty of cool air, and to be located off the ground so they can stay clean. Ideally, they should be located under a shelter on the roof.


Australian Government
Department of Industry

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Figure 2 - Ideal installation of condensing units (source Minus40)

A range of conditions can limit the condenser's efficiency – poor physical condition, poor location, and poor airflow. If one or more of these conditions is present, the condensing temperature will rise, resulting in additional power use by the compressor.

The compressor's work is determined by the difference between the evaporating temperature and the condensing temperature. For every 1°C that the condensing temperature rises, the compressor will use between 2% and 4% more energy. The larger the temperature difference, the more compressor work is required.

Lowering the condensing temperature by improving air flow around the condenser improves its performance, resulting in energy savings.

**2. Install a modern hot water system** – most small hot water systems still use direct electric heating, which is the most expensive option. A $CO_2$ heat pump and solar thermal heater with electric/gas boost are both more cost-efficient alternatives.

The $CO_2$ heat pump transfers heat from the ambient air into the $CO_2$ through a heat exchanger. It is then compressed to a high temperature. Heat from the $CO_2$ is then transferred to the water through a heat exchanger, and the hot water is stored. Water temperatures up to 80°C can be achieved.

In general:

- For an electric heater: 1kW electric = 1 kW heat
- For a $CO_2$ Heat pump: 1 kW electric = 5 kW heat

$CO_2$ is an environmentally benign refrigerant which has no negative environmental impact when released into the atmosphere (the quantities are minute and do not contribute to overall $CO_2$ emissions). As the heat pump consumes five times less power than a traditional electric heater, large energy savings can be achieved.

Alternatively, the hot water can be generated by a solar thermal system, which absorbs solar heat and transfers it to the water. The water temperature fluctuates over time and an electric or gas boost can be used during winter. On sunny days, where the boost is not required, the hot water is generated at no cost.

**3. Insulate cold lines** – suction lines from the coolroom to the condensing unit or compressor are cold and must be insulated.

Check the insulation regularly to make sure it is in good condition and well protected.

Closed-cell foam insulation is common with refrigeration systems.

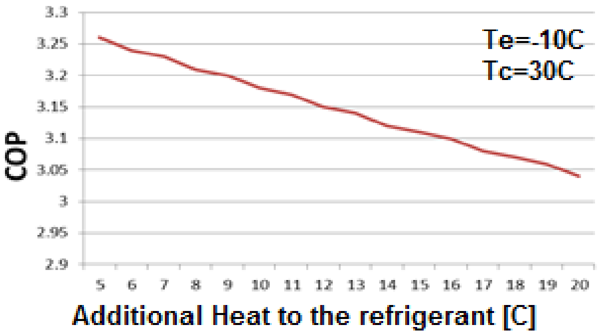


Figure 3 - Increasing suction refrigerant temperature degrades Coefficient of Performance (COP) (source – Minus40)

It is easily damaged by traffic, rain and ultra violet light, so exterior insulation must be clad. Insulation joints should be sealed and glued.

As the temperature of the suction line increases, the discharge temperature at the compressor increases, decreasing performance and efficiency accordingly.

Effective cold line insulation improves compressor performance, resulting in energy savings. There is a loss of refrigerating capacity of 1% for every 2.5°C that the suction line is heated above optimum.

Figure 4 - No insulation, leading to ice formation (source – Minus40)

## EXPLOITING MODERN TECHNOLOGY

Any new system should take advantage of modern, efficient components. However, some components can also be retrofitted to existing systems.

- Fan, pump and compressor smart controls can be adapted to compensate for variable conditions such as ambient temperature, and refrigerant load variation. This avoids needless operation and wasted energy.
- Strip curtains can be used on cool rooms and freezer rooms. They are low-cost and are effective if well maintained. However, strip curtains need frequent care to maintain hygiene levels and to retain visibility. They are well-suited to applications without heavy traffic, or where there is personnel access only.

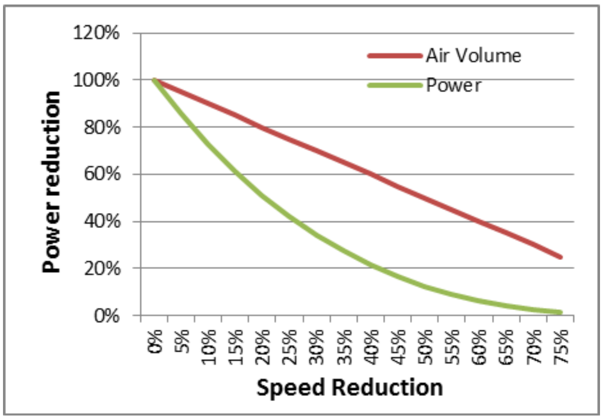


Figure 5 - Fan power versus speed (source – Minus40)

- Fan speed control – this provides a quick payback period, sometimes less than two years. A 20% reduction in fan speed equates to a 50% reduction in power consumption and a 40% reduction in fan speed equates to a 75% reduction in power consumption. Speed control can be implemented by either electronic motor control, or variable speed drive.
- Speed control of compressors rather than cycling them on/off. Variable speed drives can be used for this – they are widely available and the price is dropping steadily.
- Other Smart control systems – many options are available such as defrost control and automatic roller doors.

## COMBINING SYSTEMS: ZERO ENERGY BILL

An optimised system can reduce the energy bill by 50-100%. The following solutions can be used in combination to make dramatic energy savings:

- Solar hot water
- Solar PV panels
- $CO_2$ heat pumps
- Glycol/$CO_2$ refrigeration systems
- LED lighting
- Smart controls
- For example, solar PV panels can power the $CO_2$ heat pumps. The $CO_2$/glycol refrigeration system can be equipped with a smart control, allowing the refrigeration system to operate with high efficiency.

## R22 PHASE-OUT

Older refrigeration designs have another problem, too: the R22 synthetic refrigerant frequently used in these systems is due to be phased out because of its environmental impact. Systems based on this refrigerant are rapidly approaching the end of their useful life.

The cost of R22 is already more than $150 per kg and all hydro-chloro-fluorocarbons (HCFC) refrigerants are scheduled for final phase-down in 2015. Consequently, the prices of those refrigerants are expected to increase further as supply decreases. R22 is not the only HCFC that will be affected by price escalation: others include R409 and R408.

Currently-available drop-in replacements and retrofit options for R22 include:

- Blends of hydro-fluorocarbons (HFCs). They have a high global warming potential and risk of fractionation, and are likely to be expensive. Some available refrigerants of this type are R407A, R407F, R407C and R438A.
- Natural refrigerants, such as propane (R290). They have a low global warming potential and low cost, but are flammable.

All retrofits have disadvantages in terms of capacity, leak risk, efficiency, oil compatibility or a combination of these factors.

USA and China have signed-off for a phase-out of HFCs (including R404A, R410A, R134A, R407A, R407F) by 2030. The phase-down of these gases starts in 2020. The Australian government has agreed to become a signatory.

## MODERN TECHNOLOGIES

**Current situation**: the refrigeration systems in many butchers' shops are often implemented with little regard to energy efficiency.

The systems are often affected by these issues:

- High refrigerant charge due to long liquid lines.

- Low energy efficiency in most cases (for reasons mentioned previously).
- Poor remote condensing unit location (often an enclosed space such as a basement).

Most commercial refrigeration systems use direct refrigerant feed to evaporators located in cold spaces such as cool rooms, freezer rooms and display cases and cabinets, and the refrigerants commonly used for these applications are generally either HCFCs (such as R22, R409, R408) or various HFCs (such as R404A, R134A, R407F).

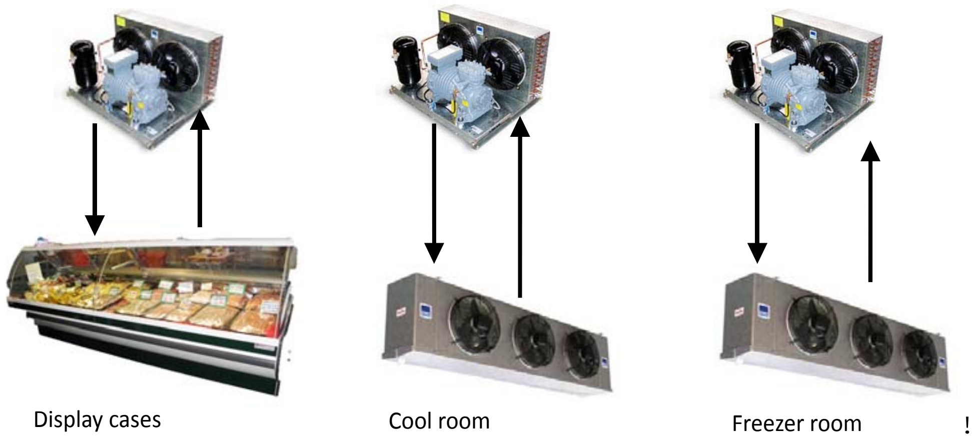


Figure 6 - Current retail refrigeration technology (source – Minus40)

**Future situation:** indirect glycol systems, traditionally used in commercial refrigeration for beer cooling, are now being used for medium-temperature cabinet and cool room refrigeration. These systems are simple to install and are effective for medium temperature applications, including small systems

When a site has both medium and low temperature requirements, combined $CO_2$ and glycol systems are attractive. The $CO_2$ system is cooled by the glycol system. These combined glycol/$CO_2$ systems can be readily scaled down to small retail applications. Well-designed $CO_2$ and glycol systems reduce or even eliminate HCFC and HFC refrigerant from the system, which reduces maintenance costs and leakage risk. Combined with substantial energy savings, they are often an attractive solution.

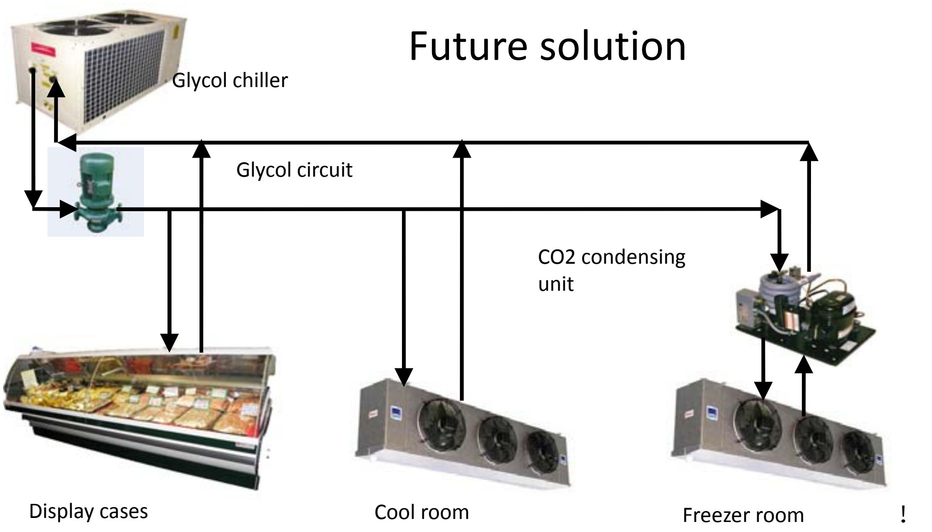


Figure 7 - Future retail refrigeration solution (source – Minus40)

## CONCLUSION

The practical and theoretical information provided in this fact sheet shows that many meat retailers have opportunities to reduce energy costs. Most could benefit from one or more of the strategies discussed in this fact sheet, but every retailer is a unique case, depending on location, building design, type and age of installed equipment and so on. Contact AMIC for information about how to obtain expert advice tailored to your situation.