WATER HEATING – M7

Eco-efficiency opportunities for Queensland manufacturers

Wasting hot water is money down the drain!

Purchasing, operating and maintaining an efficient hot water heating system can reduce greenhouse gas emissions while also reducing energy and water consumption. These environmental benefits can equate to big costs saving in not only operating the water heater but also in extending the life of the system.

Choosing a water heater - what to consider?

Before purchasing or replacing a water heater, manufacturers should consider the following:

- How much hot water is required?
- Can hot water use be reduced through efficiency measures? (For ideas on how to reduce water use, refer to the Metering and monitoring, Cleaning methods and practices (M9) and Wastewater treatment and technologies (M8) fact sheets in this series.)
- What temperature water is required and does that vary in different parts of the plant?
- When and where is hot water required e.g. during the day or night, which parts of the plant?
- Are there business constraints such as space, location, access for maintenance, visual amenity, funds?
- Are there business opportunities such as new technologies, alternate fuel sources and higher efficiency systems that can reduce energy, water, greenhouse gas emissions and maintenance costs and improve the system's lifespan?
- What is the business climate e.g. government policies to reduce energy consumption and greenhouse emissions? Are there government rebates and grants for installing energy efficient systems?

Storage water heaters

Storage water heaters have a heating element inside a tank that heats water. In Queensland, the element is typically powered by "off peak" or "peak" grid electricity but can also use renewable energy sources, natural gas or LPG.

Grid electricity - off and on peak

"Off peak" electricity heats water in the tank only when the demand of electricity is low, and thus cheaper to generate. As most businesses will use water during peak periods, storage tanks must be correctly sized to meet demand. Undersized tanks will result in insufficient hot water to meet demand. However, oversizing tanks will result in unnecessary energy consumption.

Sometimes due to space constraints storage water heaters may not be large enough to meet daily hot water requirements. In this case “peak” electricity, available 24 hours a day, is required to produce additional hot water. As it is more expensive to generate electricity in peak demand periods, peak tariffs are considerably higher than off peak electricity.

Electric storage water heaters generate more greenhouse gases than any other water heater. Businesses with electric systems can reduce their emissions by purchasing GreenPower from their energy retailer.

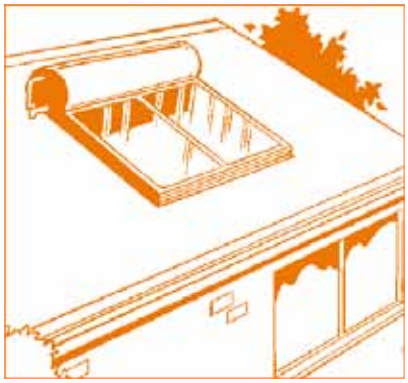
GreenPower is electricity that comes from a renewable energy generation source such as solar, wind, mini hydro or biomass. Energy retailers must ensure the percentage of GreenPower purchased by businesses is matched in the grid with energy from these renewable sources. The more businesses that use GreenPower the more renewable energy Australia can produce.

Businesses wanting to reduce their greenhouse gas emissions should include the additional operating cost of GreenPower in cost calculations of electric systems when comparing with alternative systems such as solar power.

For more information visit: GreenPower www.greenpower.gov.au/.

Energy intensive electric hot water systems will no longer be installed in new homes by 2010 and by 2012 systems in existing dwellings will be replaced by solar, gas or heat pumps. While this initiative does not currently apply to the manufacturing industry, businesses replacing or installing new hot water systems should consider the implications such as the availability of parts.

Solar energy



Closed-coupled solar hot water system

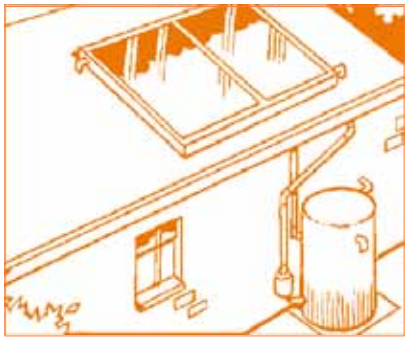
Solar collectors

Solar water heating is particularly suitable for Queensland’s climate. Using the sun’s energy instead of non-renewable fossil fuels has the potential to dramatically reduce greenhouse gas emissions. The financial benefits of installing solar water heaters will largely depend on the site’s hot water usage and the system’s performance and cost. In some cases solar may only be suitable for meeting a manufacturing site’s auxiliary needs e.g. showering and kitchen use, while for other sites there may be benefit in harnessing the sun’s free energy for heating or preheating process water.

Solar collector systems typically consist of a collector facing the sun and an insulated storage tank. Solar systems will normally have an electric or gas booster for periods of insufficient sunshine.

Flat plate collectors usually consist of copper tubes, attached to a dark-coloured metal plate, that are typically enclosed in a water proof case. Heat from the sun is absorbed by the plate which causes water in the pipes to become hot and rise though a natural process called thermosyphoning.

The hot water flows to an insulated storage tank forcing cooler water at the bottom of the tank out and into the bottom of the collector pipes. This water will then heat up and so the cycle continues for as long as the sun is providing heat. Ideally collectors should be north facing to achieve maximum performance.



Remote couple or split solar hot water system

Tanks mounted on the roof are called **close-coupled systems** and are located above the collector so they can use gravity to circulate the water. Before installing close-coupled systems, check that the roof is strong enough to carry the weight of the tank.

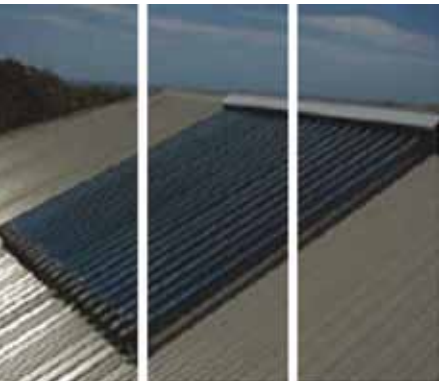
If the roof is overly exposed to cold winds and low temperatures it may be possible to install the system within the roof. These systems still use the same principles as close-coupled systems but are called **remote thermosyphon systems**.

Storage tanks on the ground, or those using existing storage tanks, are called **remote coupled or split systems**. Such systems have the advantage of easy access for maintenance and may be visually less intrusive. They do however require a pump that uses a small amount of electricity, to circulate the water from the tank to the collector.

Some flat plate collectors heat water indirectly using a mixture that flows through the collector before transferring the absorbed heat to the water via a heat exchanger.

LAUNDRY INSTALLS SOLAR TO PREHEAT BOILER WATER[1]

A laundry and dry cleaning business replaced twelve 15 hp gas fired steam boilers with two 15 hp gas fired boilers and a solar, gas boosted hot water system. The solar system consists of thirty solar panels and nine 315L storage tanks now provided 75% of the energy required to heat the 5000 L of 75°C hot water used by the laundry daily.



Evacuator tube collector

Evacuated tube collectors are relatively new on the market and are made from multiple copper tubes encased in two layers of glass with a vacuum in-between to help reduce heat loss. The tubes contain a liquid that turns into a hot gas when heated by the sun. The heat in the hot gas is transferred to water that is pumped up to the roof. Because of the cylindrical nature of the pipes there is always some surface exposed to the sun throughout the day. Evacuated tube collectors are more expensive but are particular good in areas with cold sunny days or areas susceptible to frost.

Preheaters feed water heated by the sun into conventional heaters. This option may suit manufacturers using large amounts of hot water or for processes with continuous hot water. These systems consist of solar collectors and a storage tank that feed into conventional electric water heaters or a continuous flow (tankless) gas water heater. The system only operates when the solar heated water feeding into the system falls below a set temperature minimising the amount of electricity or gas required to heat the water.

Solar concentrators

The technology of solar collectors is fast improving. For example, recent developments in solar concentrators use lenses, mirrors or dye coated glass to focus sunlight into a small beam to achieve higher efficiency and temperatures compared with conventional solar systems. This should improve the reliability, performance and cost of solar water heating and power systems in the near future.

Heat pumps

Heat in the air can also be used by solar heat pumps to heat water. Heat pumps work on the principal that heat will naturally move from higher temperatures to lower temperatures. The heat is absorbed by a refrigerant liquid which is kept at a temperature lower than the outside air temperature. The heat causes the refrigerant liquid to turn into a vapour, that when compressed turns to a hot vapour which can be used to heat water.

The compressor uses an electric motor, however heat pumps typically use 75% less electricity than a conventional water heater.[2] Heat pumps can also remove heat from water, soil, bedrock and even process wastewater.

A disadvantage of heat pumps is that they have moving parts which require maintenance. The system also generates levels of noise similar to an air-conditioning unit.

Heat pumps do not require sunshine and may be useful for businesses where the roofs are not suitable for solar systems, for example are shaded or not north facing.

Businesses that install solar hot water systems should qualify for Renewable Energy Certificates (RECs). A REC represents the equivalent of 1000 kilowatt hours of renewable energy generation and can be traded on an internet based registry managed by the federal Office of the Renewable Energy Regulator (ORER).

In most cases the suppliers of solar systems will claim any funds recovered from RECs when quoting to installing a system and will manage this process. If manufacturers wish to trade their RECs, they should contact several RECs trading agents before agreeing on a price. For a list of agents or more information visit **www.orer.gov.au/recs/#who**.

Businesses may also be eligible for funding to install energy efficient water heating systems. For current information regarding available funding visit: **www.grantslink.gov.au/**.

1 Going Solar, 2005, Case Studies - Karl Chehade Dry Cleaners & Laundry, SA
www.goingsolar.com.au/pdf/casestudies/Dry_Cleaner_and_Laundry.pdf
2 Logan City Council, 2009. Heat pump / solar hot water system information.
www.logan.qld.gov.au/LCC/logan/environment/sustainability/heatpumpsolar.htm

Natural and Liquid Petroleum Gas (LPG)

Natural gas produces around one third of the greenhouse gas emissions of coal fired electricity.

All gas water heaters and solar water heaters with gas boosters display energy rating labels. The greater the number of stars the more energy efficient the water heater. As gas is available 24 hours a day, gas storage tanks also tend to be smaller than their electric equivalents. Where natural gas is not available LPG systems are an alternative, however the running costs are higher.

Instantaneous water heaters

Instantaneous hot water systems heat water as it is used and are therefore ideal for sites with restricted space and access for a storage tank. The size of the system is based on the size of the burner rather the size of the tanks. Standard units typically only supply heated water to one tap however high power units are available that can service several taps. They typically operate on natural gas or LPG but can also use three phase electricity.

Operating hot water systems efficiently

Some actions to improve efficiency of hot water system operation include:

- Setting the heater's thermostat to a level appropriate for the purpose of the hot water. Setting the temperature too high wastes energy in unnecessary water heating while setting the temperature too low can allow the growth of harmful bacteria such as Legionella.
- Insulating the tank and hot water pipes to reduce heat loss. Place the tank in a position sheltered from the weather and if possible in a location where the pipes between the tank and points of use are as short as possible.
- Turning off the system when the business is closed for extended periods to prevent unnecessary water heating.
- Considering the installation of dedicated units if significantly different water temperatures are required throughout the plant. Make sure dedicated units are only operated when needed.

Reducing hot water use

Reducing hot water use can reduce energy consumption as well as water consumption. Some ideas on how to achieve water reduction include:

- Educate employees to use hot water efficiently e.g. dry cleaning first. Provide training and incentives if necessary.
- Look for opportunities to reduce hot water use.
- Install flow restrictors and low flow shower heads.
- Use water efficient equipment and appliances.

MULTIPLE SAVINGS FROM IMPROVED CONVEYOR BELTS

Food processing company, Australian Food Corporation, replaced interlocking conveyor belts with smooth belts to reduce the amount of water used in cleaning. The interlocking conveyor belts required significant amounts of cleaning as product lodged in the crevices in the interlock. The new smooth belts limit the possibility of product capture and require significantly less cleaning time, providing better results on cleanliness testing. In addition to the water, energy, time and food safety benefits, long term maintenance has also been reduced. The belts cost approximately $4,000 each to install and resulted in saving 788 kL per year of water and 46,000 kWh per year in energy to heat the water.

Maintenance of hot water systems

Energy use can be reduced through appropriate maintenance including:

- Checking for leaks in the entire system.
- Removing sediment from the bottom of storage tanks at least annually by opening the drain value on the tank and flushing until the water turns clear.
- replacing sacrificial anodes every few years, if currently used to reduce tank corrosion
- testing and cleaning gas water heaters as per the manufacturer's specifications to ensure the fuel is being burnt efficiently and that heat exchange surfaces are not covered in scale or soot.

This series of fact sheets provides examples and suggestions to the modern manufacturer on how to achieve both economic and environmental benefits from eco-efficiency. Visit the project website **www.ecoefficiency.com.au** for more ideas and case studies.

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