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Far left: heating head before insulation and, left, after insulation

Top tips to help you reduce your nursery heating costs

HYDRONIC HEATING systems are widely used in the nursery industry and can be very economical if designed and installed to suit the greenhouse and production system used.

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Australia's Smart Farming Partnerships are government and industry-funded projects to develop, trial and implement innovative tools that lead to practice change and more sustainable, productive and profitable agricultural industries and systems

However, if these systems are not maintained and updated, they can increase energy costs considerably. This article looks at different hydronic (hot water) heating systems used in propagation houses and presents examples of how some nurseries have reduced their heating costs.

As part of the Energy Savers Plus Program Extension (ESPPE) project, the Nursery & Garden Industry Queensland (NGIQ) in partnership with Queensland Farmers Federation (QFF) and funded by the Queensland Government, conducted 26 energy audits on propagation nurseries to identify energy savings.

It was surprising to find many nurseries are still using a heating system that was designed in the 1980s.

These systems use electric heating elements mounted in galvanised steel pipe with no hot water storage. They sit in the corner of a shed and are only turned on when necessary, because of the high energy cost. They usually have three heating elements with a combined energy rating of 10 to 12 kilowatts (kW). Running one of these systems for 12 to 16 hours overnight for three months can be equivalent to an average household's yearly energy cost.

An average household kettle uses around 2,000 watts (two kW) for only a few minutes. However, if that kettle was on for one hour it would use two kilowatts per hour or two kWh.

Consider that the average household uses between 8 and 18 kWh per day and one of these old heating systems uses approximately 160 kWh per day.

Over a three-month period that is about 14,400 kWh for heating alone, costing between $3,657 and $4,665 depending on which tariff you are on. For some small to medium nurseries, that could be half of their yearly electricity bill.

Although these systems are simple and do heat water for the propagation benches, between 25% to 40% of the energy used to heat the water is lost to the atmosphere before it reaches the plant's root zone.

When the system is turned on and the galvanised pipes heat up, it dissipates heat to the atmosphere at a rate of about 100 watts per meter of pipe per hour. For one nursery, the heat loss was calculated at 35.2 kWh per day costing $958 over a 123-day heating period.

In most cases the heating head is in another building away from the propagation tunnel and distribution pipes from that head to that tunnel usually lay exposed on the cold and possibly wet ground.

While poly or PVC distribution pipes do not lose as much heat as galvanised pipes, laying exposed hot water pipes on wet cold ground will draw heat from the pipes before the hot water reaches the propagation benches. To compensate, the heating elements run for longer, increasing electricity use and costs.

There are several ways to reduce heat loss and costs, from cheap simple fixes through to a complete system or greenhouse upgrade.

The simplest fix is to insulate your heating head pipes and if possible, the distribution pipes. This can be done either by installing an insulation wrap or lagging used on hot water pipes to stop heat dissipation during heating and transfer.

Upgrading an old analogue thermostat control to a digital control unit can reduce heating costs as new digital temperature control units are more accurate and allow more precise temperature control.

Cleaning or replacing old rusty temperature sensors and calibrating thermostats regularly will help to reduce heating costs by improving the accuracy of the temperature control unit further.

Installing a standard domestic hot water system on small heating systems will help as they are already insulated. The hot water system would operate as usual to maintain the water temperature within the storage tank, and the existing heating elements would operate as a boost system if required.

A temperature sustaining valve would need to be installed to ensure pipe temperatures do not overheat and damage plant roots or pipework.

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Another solution is to replace the heating head with a solar hot water system or heat pump and install an insulated hot water tank. This is a more expensive option. However, this option will reduce heating costs as the water is kept at a higher temperature in the tank, and the water can be heated during the day with solar energy.

This system can be scaled to suit requirements and, with a correctly sized water tank and insulated piping, continuous heating of the water during the night may not be needed.

No matter how efficient the heating system is, the type and condition of the greenhouse also has a major influence on overnight heat loss.

Solution	Cost to Implement	Energy Savings (kWh/yr)	Cost Savings ($/yr)	Payback (years)	Return on Investment
Upgrade thermostat controls & calibrate sensors	$185	393	$81	2.3	44%
Insulate heating head pipe & distribution pipe	$614	2,094	$479	1.3	78%
Add traditional hot water system & insulate pipes	$2,549	8386	$1855	1.4	73%
Replace with solar hot water, insulated tank & new hydronic heating mats	$9,465	11,041	$2173	4.4	23%
Replace with heat pump, insulated tank & new hydronic heating mats	$17,500	18,000	$3,712	4.7	21%
Upgrade the greenhouse to retain more heat	$59,000	8,000	$11,650	5.1	20%

Table 1: examples of upgrade options identified during the Energy Savers program showing the potential economic benefits and payback times

The insulating ability of the greenhouse covering and whether thermal screens are used will determine how well heat is trapped in the greenhouse. If the greenhouse is open, or has damaged and torn covering, air exchange is increased during the night causing heat loss and cold areas throughout the greenhouse. Heat loss is increased with increasing cold winds causing a greater reliance on the heating system. Upgrading the insulation capacity of the greenhouse can help to reduce heating costs by up to 40%.

If heating costs are a major concern for your business, it is well worth the cost of upgrading the heating system and associated equipment.

Talk to a local heating specialist and install a power meter to monitor the heating system energy use. A more efficient heating system will lower operating costs and has been known to improve seedling survival rates and plant health. Simple low-cost solutions are a good place to start (see Table 1).

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