



Energy conservation in glasshouses

SUMMARY Supplementary heating of glasshouses and conservatories enables gardeners to grow exotic plants that are susceptible to low temperature, especially frost, and to raise plants for early cropping.

The Royal Horticultural Society recommends ways of designing, equipping and managing glasshouses and conservatories to minimise fuel consumption by means consistent with providing good growing conditions.

Not only do these measures reduce costs, but they also limit the production of gases that promote climate change, while conserving precious energy resources.



RHS policy statements

- 1 The Royal Horticultural Society encourages interest and enthusiasm for growing plants that need a warm glasshouse regime. In doing so, the RHS supports the conservation of natural resources through economy in the use of heat in glasshouses and conservatories.
- 2 The RHS promotes and demonstrates through its gardens and advisory services the importance of fuel conservation in heating garden structures. It emphasizes methods by which energy consumption in glasshouses can be reduced by choice of structure, siting, screening, mode of heating, and supplementary insulation.
- 3 The RHS practises energy conservation in the glasshouses and ancillary buildings at its own gardens.

Energy conservation in glasshouses

Introduction

Glasshouses maintain a protected environment around plants in which warmer temperatures can be maintained than that outdoors. Solar radiation is often sufficient for this purpose in the day, but in winter, in overcast conditions and at night, supplementary heating is required.

This involves the use of fuels. Fuel resources are currently mainly non-renewable fossil fuels (oil, gas and coal) and uranium (nuclear energy). In the future renewable resources are likely to be used more widely but are unlikely to form a significant proportion of British energy supplies in the near future. Fossil fuels are also the major contributor to 'greenhouse gases' that are understood to contribute to climate change (www.rhs.org.uk/research/Sciencereport/Climate.pdf).

Gardeners can reduce their consumption of fuels, lower their costs and minimise their impact on the environment by selecting the most appropriate glasshouse design, heating equipment and management regime.

Glasshouse design

Shelter from wind keeps heat loss to a minimum. Hedges, artificial windbreaks, walls and other protection are suitable. However, shading should be minimised by keeping protection four times its height from glasshouses, especially to the south. However, in small gardens this may be difficult to achieve.

Glasshouses, as a general guide, lose up to 40 percent of light by reflection from the glazing and from absorption by glazing, dirt and the structure

itself. Therefore any other shading should be avoided, especially in winter. A position where full use can be made of winter sunshine helps plant growth and reduces heating needs. An east-west orientation captures most solar radiation.

Lean-to glasshouses and conservatories require least heating. Walls provide high levels of insulation, and in the case of house walls some heat will pass through the wall to warm the glasshouse or conservatory.

Free-standing glasshouses have the highest heating requirements, but replacing the glazing near ground level with timber or masonry can limit heat loss, as these materials are less conductive of heat. Sunken glasshouses are especially well insulated, but seldom practical for amateur gardeners.

Glass is the best glazing material in most cases because of its unique properties of high light transmission and allowing in solar heat energy, but trapping heat re-emitted from soil, structure and plants. Double-glazing requires a much stronger structure than single glazing and this casts so much shade that, added to the loss of light by absorption and reflection through two sheets of glass, there is usually insufficient light for good growth in the critical period of early spring.

However, glass is expensive, heavy, and brittle. It can cause injuries. Safety glass can be used, but this is more expensive and heavier. As a compromise it is often used for doors and panels where limbs could come into sudden contact with the glass.

Plastic materials can offer an alternative. Double-layered polycarbonate is costly and transmits slightly less light and does not trap re-emitted warmth. It breaks down in sunlight over the years and is more prone to scratches, but makes a rigid, well insulated, safe and vandal-proof covering, that gives almost as good results as glass.

Glazing materials that alter the quality of light, often used to reduce the amount of heat entering conservatories, are not recommended for use where plants are being grown. Their use can lead to abnormal growth.

Single layered sheets of polycarbonate or acrylic sheets may flex, loosen and blow away in gales. They are poor insulators, although relatively inexpensive.

Robust, smart, polythene-covered tunnels are sold for garden use, and can be covered with films treated in ways that make them nearly as efficient as glass. Tunnels offer an economical alternative to unheated glasshouses

Glasshouse and conservatory framework may be made of timber, plastic or metal. Metal is the strongest material and therefore metal structures are the least bulky and cast the least shade. Although metal conducts more heat than either plastic or timber, the practical differences are minimal and metal is usually the best construction material. Metal is longer lasting and has the least maintenance requirements.

Heating

Without heating, glasshouses are limited in winter to growing alpinas, lettuces and other hardy plants.

The degree of heating required depends on the plants being grown. Most gardeners require a glasshouse that can be kept frost-free with minimum temperatures of 3-7°C. Where hothouse plants are being grown minimum temperatures of 12-16°C may be necessary.

Where only a few plants need high temperatures, it may be better to let these take their chances on windowsills indoors or buy fresh material each spring. Cuttings of tender plants can usually be overwintered more economically than larger plants, perhaps using a windowsill or heated propagator rather than heating the whole glasshouse.

Electric heaters are the most adaptable source of heating for smaller glasshouses and the most efficient means of maintaining

specified temperatures. Thermostatic control ensures no wastage of heat resulting from changing external conditions. There are no fumes and no need for ventilation when the heaters are in use. Use of off-peak electricity, with an appropriate meter, will reduce running costs.

Moveable fan heaters or fixed tubular heaters are both effective heat suppliers. Fans provide moveable sources of warmth for sectional glasshouses (and changing crops) and can be used to enhance air circulation in summer.

Gas heaters, fuelled by bottled gas or natural gas from the mains, are less efficient or convenient than electric heaters. They discharge water vapour and fumes into the glasshouse as they burn and so some ventilation is important, which will allow some heat loss. Thermostat settings may be less precise. A safe place is needed for gas cylinders, which need regular monitoring and replacement. In the future gas may be used to run fuel cells that produce electricity.

However, this is not yet feasible for small glasshouses or conservatories.

Heating glasshouses with solid fuel boilers may require gardeners to stoke boilers during the night, and are a very inefficient and polluting means of burning coke or coal. Biofuels, such as woodchips, may offer a solution for larger glasshouses in the future. This could be a more environmentally sensitive, if costly, way of providing low levels of glasshouse warmth.

Solar heating is at its least effective when glasshouses and conservatories have the highest heating need. Wind power is so costly to install that it is unlikely to be feasible.

Glasshouses maintained at low temperatures are most suitable for gas or paraffin heating, as less fuel is burnt than when high temperatures are needed. This results in much less water vapour and combustion fumes, both of which are potentially harmful to plants.

Lean-to greenhouses and conservatories can be heated by an extension from the house's central heating. This can take full advantage of modern, highly efficient condensing boilers.

Paraffin heaters provide the most basic means of glasshouse heating. They have the disadvantages of gas heaters and, in addition, need frequent re-filling and wick-trimming. Thermostatic control is not possible with models for domestic use. Paraffin heaters are useful for reducing the risk of frost damage in smaller glasshouses and as an emergency standby.



Bubble polythene provides useful insulation

Glasshouse management for fuel economy.

Maintaining the lowest possible temperatures will greatly reduce fuel consumption, but will result in slower plant growth.

Good quality maximum-minimum thermometers are necessary to manage a glasshouse, allowing adjustments to be made to heating and ventilation. Gardeners should be aware that heat levels can be very variable within a glasshouse and check the temperature throughout the structure. A fan to distribute heat may be necessary to avoid overheating some areas and under-heating others.

When only some plants require a higher temperature, constructing a partition, perhaps using timber battens, and bubble polythene material, saves having to heat the whole glasshouse. Using electric propagators to maintain extra warmth to strike cuttings and germinate seeds also avoids the need to heat the whole glasshouse. A covering of horticultural fleece over the plants at night can provide a warmer microclimate at plant level so that lower temperatures can be maintained.

Temporary insulation by lining glasshouses with bubble polythene can significantly reduce heat loss. However, the three layers of polythene used in this material markedly reduce light levels within the structure. As plant growth is directly related to light intensity, this might be unacceptable in winter. A compromise is to line the north and east sides only, allowing low incidence winter sunlight to enter via the south and west quarters.

Cleaning the glazing and removing moss and algae where panes overlap will increase light transmission into glasshouses and make linings more feasible.

Shading needed in summer to prevent overheating should be removed in early autumn and replaced in mid spring to allow maximum light levels over winter. Roll-up shading will help prevent heat loss if rolled down on cold nights.

Heat loss caused by draughts passing through ill-fitting glazing, doors and ventilators can be significant, especially in windy weather. Lining with polythene materials, and using mastic guns and clear flexible sealant to reduce draughts, will conserve heat and reduce fuel use.

Thermal screens of aluminised fabric, supported on wires, can be drawn over the glasshouse at night, at just above head height to reflect radiant heat back into the glasshouse. Although widely used in commercial glasshouses, the cost of automating these is unlikely to be justified in domestic situations, but is worthwhile where gardeners are able to spread and furl the screen manually.

A downside of plastic linings and reducing ventilation is the potential build up of humidity. Water drops condensing on the glass will reduce light transmission, and drips and damp air increase plant losses from waterlogging and disease. Electric heaters and radiators are least likely to cause this problem, while paraffin and gas heaters are likely to exacerbate humidity problems. Where excessive humidity occurs, it is necessary to raise heat levels and open vents to dry the structure. Unless warm, sunny days occur, this will increase fuel use.



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