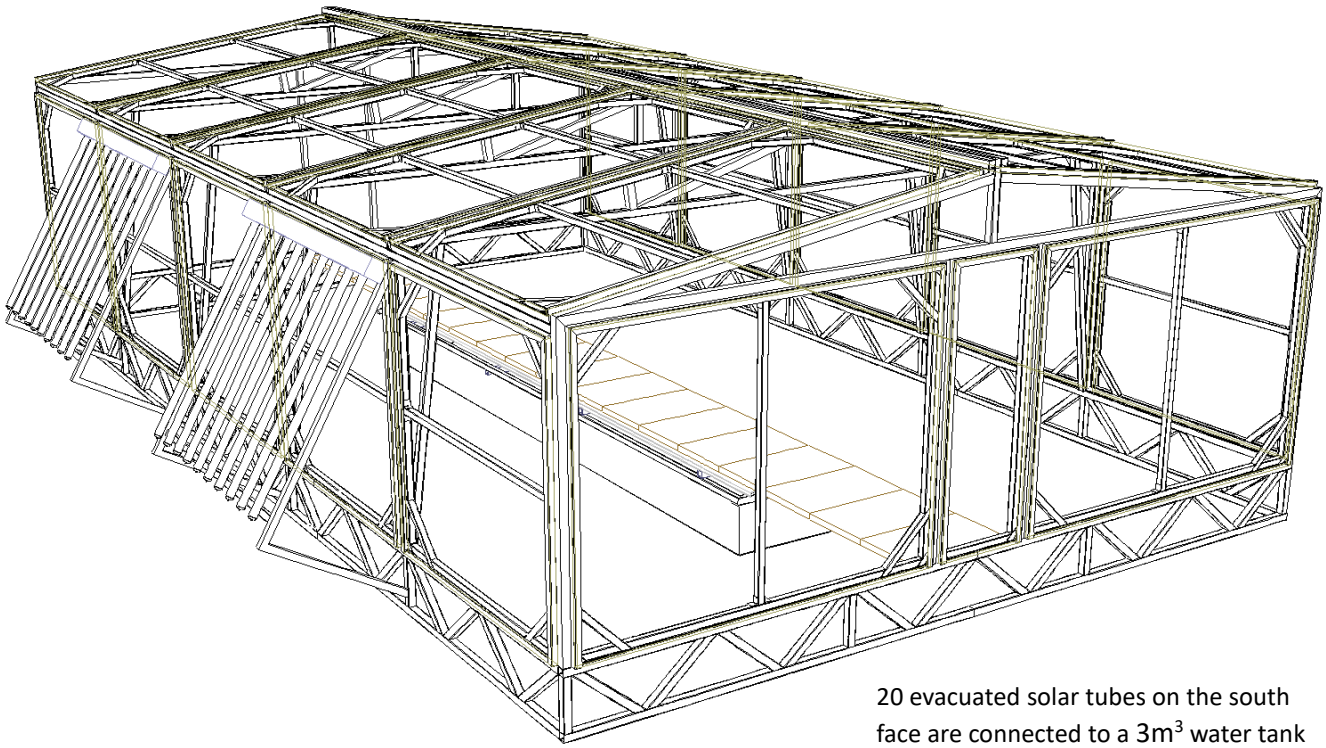
A Greener Greenhouse

A new building material

Pultruded fibreglass may be an unfamiliar material but it's surprisingly easy to use. 60mm box is available off-the-shelf. It is light, warm-to-touch and doesn't need painting. It can be assembled using an electric drill and self-tapping screws. Structural frames made of 60mm box are as strong as steel but light enough for one or two people to carry. They will not rust or rot and need no maintenance. They are far more thermally resistant than any metal. Used with polycarbonate multiwall sheet, they enable insulated greenhouses to be built more quickly and at lower cost than conventional greenhouses.

A new structural system

Structural frames at wide centres can be built quickly and easily on any site. They require no concrete or wet-trades. A shallow perimeter trench holds a rectangle of box trusses to support the greenhouse. Frames built on top at 2.2m centres enclose 35mm polycarbonate multiwall sheets 2.1m wide. Greenhouses are modular. The example shown is 6.6 m x 11 m, giving a 72m^2 footprint. The same components can create a footprint of any size.



20 evacuated solar tubes on the south face are connected to a 3m^3 water tank under the central walkway

Winter heating without fossil fuels

20 evacuated solar tubes on the south face of the greenhouse are widely spread to limit shading of the greenhouse. They are used to heat 3m^3 of water in a central tank that is set into the ground. There is a walkway above. Over the summer, this tank can be heated to 40°, which will heat the earth around it. This then becomes a heat store. Excess heat can be taken from the tank and replaced by mains water at 12°. Circulation will resist growth of algae. The hot water taken from the tank can then be sprayed on the greenhouse roof where it will soon evaporate. Evaporation will cool the greenhouse. By this means, the interior temperature is balanced. Continuous growing conditions are maintained all year-round at minimal cost. The tank and 70m^3 of earth around it may hold 500 kWh of heat energy by the end of summer. With a U value below 1.1 W/m^{2}k, the greenhouse may need no additional heat all winter after topping up on sunny days.

UK climate

The average mean UK temperature in December is 4.5°. Every four years or so, there may be anomalous cold weather, when average temperatures could drop by 5.5° to -1°. Raising the greenhouse temperature by 5° to keep it above 4°, will consume 0.675 kW of energy per hour. It may be necessary to do this for 14 hours of winter darkness, consuming 9.45 kWh of heat from the ground below the greenhouse. If the heat in the ground and central tank becomes depleted, a 3kW immersion heater running on off-peak electricity, could provide this heat for less than £1.20 a day. No fossil fuels will be used to keep plants free from frost. Once in four years, the cost of warming say, 15 anomalously cold nights will be just £18. There have been only three winters in the last 80 years when cold spells have lasted for 28 days or more. The heating cost for 28 days would rise to £34. The cost of installing and running this back-up is minimal.

Other countries and climates

An insulated greenhouse with a thermal store in the ground below is adaptable to other countries and climates. It uses solar heat and water to balance internal temperature for optimal growing conditions at the lowest cost. Depending on climate, any additional heat required in winter can be supplied without fossil fuels. For example, in northern climates like Norway and Sweden, hydro-generated electricity is widely available at a low tariff to compensate for lack of sunshine in winter. In southern climates, winter sunshine is much more abundant. Additional electrical heating may not be necessary.

There is an opportunity for collaborators to develop this technology for use in any country. It can be scaled down for domestic use or scaled up to cover large areas for commercial businesses. A solution that makes horticulture adaptable to climate change, is ready for exploitation.