Horticulture Towards Net Zero

What are the key emission challenges influencing this sector?

Energy and fuel use

Heating typically accounts for 90% of the energy used in greenhouses[1]. Studies for tomato, cucumber and flowers showed that heating in greenhouses is the largest contributor of greenhouse gas emissions.

Nitrogen use

Emissions from the cultivation of soils and the production and application of mineral fertiliser are the largest contributors of nitrous oxide emissions from field-grown products[2].

Water scarcity

The majority of UK catchment areas in which horticultural production is concentrated have already been defined as being either over-licensed and/or over-abstracted. Retaining access to reliable supplies of water in the future will be a major priority[2] and efficient water usage will become more prevalent.

Loss of organic and peat soils

40% of UK vegetables are grown in areas of lowland peat. Drainage of carbon-rich peat soils contributes to emissions as topsoil erodes. In some areas, a complete loss of peat soil could occur in 30 to 60 years[2].

Where should you start to prioritise reducing emissions on your farm?

Approximately 161,000ha of horticultural crops were grown in the UK in 2021 comprising 3% of all arable land, and accounting for 2.5% of the total UK agricultural emissions[3]. Approximately 19% of farm/grower emissions are from heating buildings, including horticulture. Adoption of automated technologies has also introduced more efficient boilers and lighting systems to help growers reduce energy use and cut emissions from fossil fuels.

Undertaking an **annual carbon footprint assessment** will assist growers to understand hotspots and target focus areas of the business. This exercise, when done on an annual basis, will help your farm to prioritise practices and increase both efficiency and productivity.

Focusing on energy efficiency is an important step and for indoor systems offers the greatest opportunity to reduce emissions. A few practical, low-cost steps you can take to increase energy efficiency and make cost savings include reviewing environmental requirements based on weather and daylight savings; keeping windows, skylights and light fittings clean as basic maintenance (can reduce costs by 15%[4]); making sure air ducts and inlets are clean to increase efficiency by 20%[4] and improve fan motor life; and replacing conventional bulbs with energy-saving compact fluorescent lightbulbs (CFL bulbs) – they last eight times longer and use 80% less energy[4].

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In addition to energy efficiency, there are six key immediate practices that can be implemented to reduce emissions at farm level:

1. Reduce water demand to improve use efficiency and reducing waste
2. Improving soil health to enhance the ability of soil to support crop health and growth
3. Nutrient management planning to ensure efficient use of manures and fertiliser, reducing ammonia emissions from volatilisation
4. Vertical farming to increase nutrient efficiency, reduce land use and protect against effects of climate change
5. Hydroponics to improve crop growth rate and improve water and nutrient utilisation
6. Tree planting initiatives to enhance carbon sequestration on your farm

What practical steps could you take?

What is the practise?	Why would this be of benefit to your farm?	How can I do this well?
Reducing water demand using precision irrigation	Precision irrigation allows for better uniformity and scheduling of irrigation, directly to the plant root. Drip irrigation is the most efficient system with 95–100% water use efficiency[5]. They use 30–50% less water than mainstream methods such as sprinklers[6].	Water is an expensive natural resource that is becoming scarcer and more difficult to secure, intensified by climate change. Precision irrigation allows farmers to apply the appropriate amount of water to crops without using more than they need or wasting it.
Optimising nutrient availability (nitrogen fixing cover crops, soil sampling & organic manure sampling)	Nutrient budgets allow farms to make optimum use of available nutrients, evaluate the viability and sustainability of crop rotations. They should include soil analysis to measure levels of available nutrients in the soil and plan additional nutrients required[7]. Test nutrient content of organic manures before spreading to ensure optimised use of the nutrients available. Implement low emission spreading techniques and incorporate manures into soil to avoid losses of nitrous oxide[8]. Investigate use of nitrogen fixing cover crops such as red clover or rye to improve soil structure and reduce fertiliser usage.	Legume species such as vetch and clover fix nitrogen, which can benefit following crops and boost fertility[8]. When utilised as a winter cover crop, this limits nutrient leaching into watercourses, retaining nutrients in the field for the following crop.
Improving soil health	Enhancing soil health is important in optimising nutrient and water-use efficiency and is a key cornerstone to sustaining long-term profitability in horticultural systems. Retaining a good soil structure and condition throughout the cropping season is essential to maintaining productivity. Improving soil standards will contribute towards improved water quality, climate resilience and biodiversity on-farm[9].	Producing a soil management plan with testing of soil structure and organic matter levels enables farms to quantify and assess soil health over a long-term period. Covering land over winter with multi-species cover crops limits soil erosion and loss of nutrients from the farm. Avoid compaction where possible by using the appropriate farm machinery in the correct conditions with controlled traffic.
Vertical farming	Vertical farms (VF) reduce land use and enhance efficiency of nutrient uptake. They provide shelter from the effects of climate change, reduce food miles, and flatline production costs. VF can also reduce land, fertiliser, water and pesticide use for greens, vine crops, herbs, and other high-value crops. VF is very energy intensive, however with the advancement of renewable energy, energy efficiency of lighting will improve, and emissions will be further reduced[10].	VF removes soil fumigants that growers conventionally use for strawberries. Growing leafy greens such as lettuce indoors can dramatically cut water use. Greenhouses use 92% less water to produce the same amount of lettuce grown on agricultural fields. VF is a resource-efficient method of farming to keep growing healthy food with minimal impact[11].

What's next? What should I look at beyond two years?

Looking ahead, agritech and land management strategies offer the greatest promise to limit emissions and enhance carbon sequestration within horticultural enterprises. Examples of actions you could consider investigating and plan for change on your farm include:

- Hydroponics offer the opportunity to use less land area, water and nutrients and can capture and recirculate water and nutrients. Plants produced hydroponically can be 3 to 10 times more numerous than they would be if grown in soil and grow between 30% and 50% faster than in soil[12]. This system also produces fewer weeds, pests and diseases and can save you time, money and resources.

- Tree planting is an effective way to increase carbon sequestration and is a key part of the Government's plan to achieve net zero emissions by 2050[13]. Trees are important carbon sinks, whilst providing value to land by supporting greater biodiversity, and flood risk management. Soil health is also enhanced by maintaining nutrient rich soils, increasing water holding capacity and aeration as well as soil microbial activity[14].
- Gas used in horticulture could be replaced with spare reject heat from other energy users or the supply of low-grade heat to third parties. This provides the opportunity to improve the efficiency and economics of the heat supply whilst also providing lower cost and lower carbon energy.
- Agritech is affording new strategies in the identification and management of pests and diseases through the use of drones or unmanned aerial vehicles (UAVs). They can be used to monitor crop health and identify pest and disease 'hotspots' in crops. Drones equipped with a scouting device can remotely locate and identify pests and diseases and then be attached with beneficial insects that can be released over problematic areas[15]. Drones can also inform reduced herbicide and pesticide use, thus reducing emissions.

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The Agricultural Mortgage Corporation plc, registered in England & Wales, no. 234742. Registered office: Keens House, Anton Mill Road, Andover, Hampshire, SP10 2NQ. Telephone: 02077 143660.

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