Renewable Energy Towards Net Zero

What are the key emission challenges?

Energy use

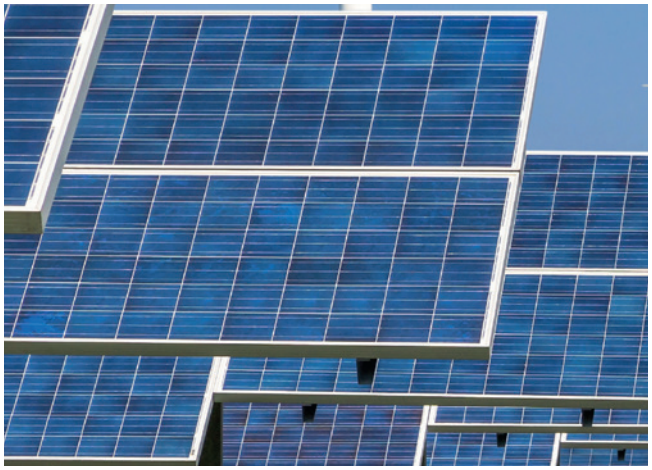
Agricultural and horticultural industries are energy and fuel intensive[1]. Many farm businesses are considering investing in renewable energy, however the reliability of supply from these systems needs to be improved, meanwhile fossil fuels are being continually used in the medium term.

Land use change for bioenergy crops

There are concerns about the type, quality, and availability of land used in the UK for all renewable energy schemes including bioenergy, wind and solar. This is as a result of productive (food producing) land being lost to energy generation.

Cost of deployment

Cash flow is essential to new renewable and bioenergy projects and support is essential if reducing fossil fuel energy use is to be achieved. As the applications for the Renewable Heat Incentive (RHI) ended in the spring of 2022, options to displace current energy costs are critical as margins can be unattractive for investing farms. British farmers are also having to contend with uncertainty related to withdrawal from the European Union and how evolving agricultural policy may impact the potential income benefits from renewable energy for agricultural businesses.



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

As the UK government transitions towards net zero 2050 targets, plans to 'fully decarbonise our power system by 2035'[2] will require the agricultural industry to aid in the production and supply of clean energy.

Agriculture and horticulture farm businesses are intensive consumers of energy and fuel but nearly 40% of farmers and growers are already using solar, wind, farm by-products and bioenergy crops to produce clean, low-carbon energy. This is a significant increase from only 5% in 2010[3].

There are still plenty of opportunities to maximise renewable energy generation in farm and grower production. Boosting the renewable energy and bio-economy could deliver estimated greenhouse gas savings of up to 26MtCO_2e/year[4].

Identifying energy and fuel impacts through an **annual carbon footprint assessment** is a key step to reducing emission losses from fossil fuels. Dependent on the type of farm/grower business you operate, quantifying energy demands versus consumption will help alleviate costs on your business as well as reducing greenhouse gas emissions.

Solar photovoltaic power (PV) generation continues to be a very attractive proposition for many agriculture and horticulture businesses. A PV system at 140kW is likely to cost c. £115k and dependent on electricity saving and export to the grid income, will achieve a payback between 4–4.5 years. The inclusion of battery storage will increase cost by c. £90–100k and extend the payback to 5–6 years.

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To continue the adoption of low carbon energy generation, there are eight key actions to consider when beginning to rethink energy and fuel consumption on-farm:

1. Solar panel pumps in grazing systems
2. Installation of anaerobic digesters to redirect energy
3. Nutrient recycling using digestates and composts
4. Low carbon machinery powered by biofuels
5. Whole system biomass planting and boilers
6. Installation of air source and ground source heat pumps
7. Install solar (PV) panels
8. Integrate new batteries designed for enhanced storage capacity

What practical steps could you take?

To assist decision marking, there are three questions that any agricultural holding may want to consider when starting to explore on-farm renewable energy and fuel options:

1. What are your energy needs and requirements? What are your areas of intense energy consumption?
2. Can you access the mains grid? Do you have three-phase power supply and how much energy can you displace of power bought from the grid?
3. Does your farm have any assets when it comes to energy generation potential e.g. south-facing location or running water?

What is the practise?	Why would this be of benefit to your farm?	How can I do this well?
Solar panel pumps in grazing systems	Solar panel pumps transport water to remote locations without the need for mains power, thus removing the requirement of vehicles and associated fuel, in turn improving soil health and reducing risk of nutrient groundwater leaching. This technology would be particularly beneficial for pastoral systems using regenerative grazing methods, including mob grazing.	Funding may be available (within certain schemes and catchments) through water trusts, as these pumps provide additional benefits to water quality of nearby river systems.
Anaerobic digesters	Anaerobic digesters (AD) convert manure, crops and crop by-products into renewable energy[4]. Biogas and digestate are created during the process, of which biogas can be utilised to generate heat and/or energy that can be repurposed on-farm or sold to the national/local grids[5]. Emissions can be saved though: a) contained storage limiting methane, nitrous oxide and ammonia emissions, b) energy produced, c) production of digestate than can be utilised on land, replacing the requirement for purchased fertilisers.	This approach is suitable for arable, dairy, and mixed farms. Conversations with other farmers who use AD would be an ideal start, then discussing in more detail with technology providers. Careful consideration of costs should be weighed up. For example, a small-scale scheme (c. 45–50kW) is likely to cost £250–300k and payback between 8–12 years. A larger 250kW scheme is likely to cost around £1 million and payback around 7–10 years.
Nutrient recycling	Digestate produced from AD can be used to recycle carbon and nutrients from farm back into the land, aiding in rebuilding soil carbon. The anaerobic digestive process alters the characteristics of the original material, increasing pH and converting organic nitrogen to ammonium nitrogen, producing biofertilizer that is rich in readily available nitrogen[6].	Utilising the bio-fertiliser produced as a replacement for purchased fertiliser provides opportunities for targeted nitrogen application to meet crop requirements, minimising nitrogen waste and leaching[7]. Effective application of this product can be covered by a nutrient management plan.

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Low carbon machinery	Farm vehicles can be powered by a range of low carbon renewable options, including biodiesel, biomethane, and electricity. Renewable biodiesel produced from waste vegetable oil and methanol is currently used on farms, reducing reliance and emissions from diesel. Electricity and biomethane generated on-farm through anaerobic digesters can be reused as a clean energy source to power low carbon machinery. Utilising waste products to generate renewable clean energy elevates pressure on use of fossil fuel and keeps on-farm emissions lower and cleaner.	Some vehicle manufacturers and suppliers offer engine configurations for B20 and higher blends of biodiesel[7]. Installing an onsite anaerobic digester will facilitate the production of biomethane and/or clean electricity, that can be fed into compatible machinery. Low carbon vehicle technology is constantly developing, speaking to technical experts will keep knowledge as relevant as possible.

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

Technology to aid in the generation of renewable energy on-farm is continuously advancing, paving an exciting future for new low carbon sources of fuel and energy to power farm activities. Although technology in this sector often has payback benefits, initial expenditure can be significant. There are several avenues to explore when looking for future support, guidance, grants and incentives:

- **Green Gas Support Scheme**
- **Smart Export Guarantee**
- **Renewable Transport Fuels Obligation**
- Funding offered by river trusts – depending on links to water and soil quality

Many areas of innovation using agritech solutions are still being researched and developed for expansion to commercial scale. Land management strategies to integrate energy crops into farm businesses also offer opportunities to limit emissions and enhance carbon sequestration. Examples of actions you could consider investigating and plan for change on your farm include:

High-yielding perennial crop species such as short rotational willow coppice and miscanthus provide farms with the opportunity to generate high volumes of biomass for energy production, often in poorer marginal farmland. Despite covering only 10,000ha in 2020[8], miscanthus and willow coppice have high potential to both reduce emissions and sequester carbon. Both crops are widely regarded as carbon neutral since the CO_2 released during combustion has first been captured through photosynthesis during plant growth.

Green hydrogen power can be produced from using surplus renewable energy (e.g. solar or wind), to power the electrolysis process that splits water into hydrogen and oxygen atoms. If agricultural equipment powered by green hydrogen fuel cells were to become commercially viable, this technology would be considered as 'net zero'. Further development of these technologies will in time unlock the potential for green hydrogen production[9].

The production of biofuels is improving in efficiency with innovative technology opening new avenues for farms. Bioenergy produced from straw using an all-in-one automated straw harvest and pelletiser machine can produces straw pellets from agricultural feed crops. These pellets are becoming increasingly used in the production of bioenergy on-farm, which is subsequently driving up the cost of pellets due to there being limited pellet production and distribution mills across Europe. This machinery can cut the cost of sourcing straw pellets externally, whilst reducing emissions associated with the pelleting process and transport of the product[10].

Visit **amconline.co.uk/sustainable-agriculture**

To find out how we can help your business, please speak to your regional agricultural manager.

References

[1] The Carbon Trust. Agriculture and Horticulture – Sector overview. 2012.

[2] UK Government: Build Back Greener (2021).

[3] **Defra. Farming statistics – Diversification and Renewable Energy Production on Farms in England 2010. 2013.**

[4] **NFU 2019. Achieving Net Zero Farming's 2040 goal.**

[5] Innovation for Agriculture. Reducing Greenhouse Gas Emission at Farm Level. 2022.

[6] Royal Agricultural Society of England: Farm of the Future: Journey to Net Zero. 2022.

[7] Royal Agricultural Society of England: Decarbonising Farm Vehicles and Future Fuels. 2022.

[8] **Defra. Plant biomass: miscanthus, short rotation coppice and straw. 2021.**

[9] **Teagasc. Short Rotation Coppice Willow: Best Practice Guidelines. 2015.**

[10] **NNFCC Agro-cycle Factsheet.**

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