Purpose grown crops (PGCs) are an important feedstock for anaerobic digestion (AD) plants, both mixed with farm and other organic waste and on their own. As well as offering a high level of energy generation, they can make a significant contribution to the economic and environmental sustainability of farming. They can help farmers generate a constant, reliable revenue stream, and complement food production, making them one of the most attractive forms of bioenergy available.

Bioenergy: A Limited Resource

The Committee on Climate Change has rightly stated that bioenergy is a limited resource which should be used in the best way possible. Policy on bioenergy should reflect the evidence on issues such the efficiency of conversion of different forms of biomass to energy.

In the UK there are 1.226 mha of temporary grassland and 9.901 mha of permanent grassland available for food production, whilst there are approximately 860,000 ha of marginal or idle lands which have the potential to produce 4.8 mt of biomass for energy production. This marginal or idle land has the potential to supply grass silage for AD without displacing any land used for food production. Other farmland can be used in rotations, or quickly and easily diverted back to food production if necessary. This is not the case with many other forms of biomass for energy.

Criteria for Comparison

As the government’s bioenergy strategy makes clear, renewable energy needs to benefit the environment and make clear greenhouse gas savings. Comparing forms of bioenergy therefore requires sustainability criteria which take account of the lifecycle carbon analysis of the production and conversion of biomass.

In order for bioenergy to make the most significant contribution possible to the UK’s renewable energy resources, it is clearly vital to extract maximum possible value from the available land. The German Agency for Renewable Resources studied this in 2008, and found that compared to other biofuels, biomethane realises significantly greater final energy in terms of kilometres which could be driven per hectare of production. A separate University of Southampton study showed that from a maize yield of 12.6 t dry matter/ha “the net energy produced is around 89 GJ/ha. This is around 5-9 times more land-use efficient than biodiesel and 2.5-9 times more efficient than wheat grain bioethanol.”

Comparison between bioenergy technologies should also take into account the way that bioenergy production interacts with farming practice. This is clearly more difficult to measure quantitatively than carbon analysis or energy conversion, but is important in terms of sustainable land management and the future of farming in the UK.

Producing biogas from purpose grown crops fits perfectly into existing farming practice, while increasing its economic and environmental sustainability. Growing feedstock for an AD plant can fit into agricultural rotations, improving soil quality, supporting food production and providing extra income sources for farming businesses. This is already the case with several on farm AD plants in the UK.

Furthermore, it is important to take into account the fate of nutrients. In most forms of bioenergy these are effectively lost; with biogas from AD, they are retained in the ‘digestate’ residue from the process and can be recycled back to the land. Digestate is an excellent biofertiliser which can replace carbon-intensive artificial fertilisers, which are responsible for 14% of UK farming’s greenhouse gas emissions. These benefits should clearly be taken into account in any comparison of bioenergy technologies.

Using Purpose Grown Crops in AD

While the anaerobic digestion of purpose grown crops is often described as a biomass technology, it is very different from other forms of biomass energy in terms of cultivation, process and sustainability. Much of the difference comes from the way in which growing crops for AD falls within farming practice rather than being separate from it.
PGCs can be (and already are) grown as break crops which help to promote biodiversity in British agriculture, complementing existing agricultural rotations and improving soil quality. The land used to grow PGCs is, therefore, not tied up for the whole year, and during the rest of the time is available for food production. Biodiversity is aided by a wider range of crops in any given rotation as different crops will have different characteristics (planting dates, flowering and harvest). While the growth of on-farm AD will of course lead to increased plantings of maize, climatic factors which favour grass over maize will mean that as much as half of the PGC requirement in the UK can be met by grass and other non-maize PGCs. This can be compared with other cropping such as oilseed rape, which currently amounts to 14.4% of arable cropping.

Sustainable Agriculture

The role of purpose grown crops in increasing the sustainability of UK agriculture should be recognised in a range of areas: preservation of nutrients; mitigation of methane emissions; renewable energy generation; and supporting the financial viability of farming. PGCs for AD can form a crucial component of a sustainable agricultural cropping rotation, increasing renewable energy production and ensuring food security, while maintaining and enhancing biodiversity.

One principal advantage of bioenergy from AD over biomass combustion is that the organic matter is not destroyed: the process produces a nutrient-rich digestate which creates a ‘closed loop’ process. In many farm-based AD plants the plant matter is also digested alongside slurry, mitigating methane emissions otherwise associated with the slurry. Bioenergy through AD contributes to the economic sustainability of farming, offering diversification of income and on-site energy generation.

Considering the wider implications for UK farming, there are already Farming Best Practice Guidelines in place to ensure that PGCs are grown sustainably. These include Standards of Good Agricultural and Environmental Condition (GAEC), Good Agricultural Practice for Nutrients and Fertilizers and Farm Assurance Schemes, and the Assured Combinable Crops Scheme.

Final Energy

Another important factor to take into consideration is the flexibility of the final fuel produced. This is vital when considering the future of renewable energy, and the options which are either available or may become available for low carbon energy in each sector. For example, using bioenergy to generate electricity will become less important as other renewable sources come online. Bioenergy used to generate fuel for road vehicles could also be replaced with other technology with lower lifecycle carbon emissions, such as biomethane vehicles or (in the longer term) hydrogen-fuelled engines. Biogas from AD has a huge advantage in this sense, as it is flexible and can be used for electricity, heat, injection to the gas grid or as a vehicle fuel as needed.