

Supplying material to existing large scale anaerobic digestion plants

Guidance for Land Managers

<p>What is this about:</p>	<p>This Code of Practice covers the information that land managers need to know when considering supplying material harvested off reserves to existing large scale anaerobic digestion plants. It sets out a process and guidance for managers to follow to aid the utilisation of their material for energy production in this way.</p>
<p>Who should read this:</p>	<p>Land managers, including farmers and conservation managers.</p>
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1. Introduction and scope

Material produced from land management operations, particularly from nature reserves, is often not utilised and under valued. This material is typically made up of single dominant species such as soft rush from wet grasslands or common reed from reedbeds. However it is possible that this biomass could be considered as a potential feedstock for bioenergy. Depending on material composition, time of harvest and tonnages produced, this biomass may be suitable for anaerobic digestion (AD). Although as a landowner you may not produce enough biomass to have your own plant, it is possible that you could supply an existing set up.

This code of practice is designed as guidance for the land manager to be able to consider the possibility of supplying an existing AD plant and the issues they will need to consider beforehand.

2. What is anaerobic digestion?

Anaerobic digestion can be used for processing green material, high in moisture content, ideally freshly harvested or if stored, in a silaged condition. Anaerobic digestion is the digestion of material in anaerobic conditions to produce biogas, which is then harvested and either directly fed into the gas grid or converted through a combine heat and power plant to produce electricity and heat. This process deals with green material well, but may struggle with material of a high lignin content such as common reed, which the micro-organisms struggle to break down due to its cell structure.

3. The world of anaerobic digestion

3.1 Knowing the value of your material

Before approaching an existing AD plant operator, it is beneficial to know how digestible your material is. This knowledge can be gained through analysis, which can determine a number of parameters which are important, such as moisture content, biogas yield and methane content. The following table provides an indication of different parameters for different materials:

Material	Oven Dry Matter %	Moisture %	Total Gas yield M ³ /t	Total Methane Content %
Reed sweetgrass	26.4	73.6	138	52.6
Common reed	35.3	64.7	185	53.2
Mixed tall fen	31.9	68.1	165	52.4
Soft rush	33.7	66.3	173	53.1
Grass silage			120-215	
Maize silage			180-210	

To interpret these figures, all the materials processed by AD plants are measured by their dry matter content. The margins for the dry matter they generally operate between are 30 to 36%. If materials have more dry matter than this it could mean that there is a higher percentage of lignified / woody material. The older the material gets the woodier it becomes which in turn

increases the percentage of lignin, and although the material may have a high total gas yield it is difficult to realise as much of it would be tied up in the lignin. Grinding this material to free up the gas yield from the lignin can help, but it is still hard to unlock. With this in mind and knowing that a high percentage of the above samples harvested conformed to the AD requirements – then this opens up another opportunity as an outlet for biomass. The figures for grass/maize silage (typical AD feedstocks) are included so comparisons can be drawn.

Appendix 1 lists laboratories where this analysis can be undertaken

3.2 Presenting material in the right form

The way in which the material is harvested on site is inextricably linked to the desired afteruse, this is illustrated well in relation to material chop-size. As described above the different heads and chop capabilities should be employed to produce the condition of the material needed. Some conversion technologies are 'less fussy' than others, but some have very little tolerance and material that is of the wrong length can prohibit its use. To overcome material being too long once harvesting has taken place is not impossible, but would involve double handling and extra processing which will have cost and carbon implications.

The rule of thumb is that for most anaerobic digestion processes that are dealing with solid material (rather than liquid) the particle size needs to be as small as possible and definitely that harvested with a precision chop rather than a double chop. However if harvesting can only be undertaken with a double chop then a mixer shredder can always be employed to down-size the material further. Although anaerobic digester systems have macerators they are typically equipped to macerate already finely chopped material. Longer cut lengths are problematic and serve to block up the system. Experience from the DECC project both with Natural Synergies Ltd and Future Biogas, is that material longer than 8mm in length will not be accepted for anaerobic digestion systems.

3.3 Specialist harvesting machinery

Machines typically used to produce forage suitable for AD, such as Claas harvesters, will most likely not be suitable for harvesting on nature conservation areas and so specialist harvesters will need to be contracted in.

Include details of harvesters and headers



Double chopped reed



Precision chopped reed

3.4 Time to harvest

Cutting biomass at different times of year can provide marked differences in its characteristics and its suitability for the conversion processes. For anaerobic digestion Viswa Raj Akulain completed a study in Sweden and found that harvesting reed in October for biogas production, produced higher amounts of gas compared to reed harvested in August. His studies showed that there was a big difference in the amounts, with October producing the highest amount of gas at 107.9 l/kg wet weight compared to reed harvested in August which produced 60.6 l/kg wet weight. These findings were surprising as it would be expected that a later harvest may lead to material having an increased lignin content which it is thought to have a negative effect on gas production.

3.5 Transport

Ensuring that the material doesn't start to degrade and to make sure that it retains its value for digestion, it is preferable that the harvested biomass is transported immediately after harvesting to its point of use. If not the material will need to be stored appropriately.

3.6 Storage

If it is not possible to transport the material immediately after harvesting to the anaerobic digestion plant then the material will need to be stored in a suitable state. Storing the material in the desired condition is key to being able to successfully turn it into energy, whether to preserve the sugars for anaerobic digestion or to maintain low moisture content for combustion, how it is stored will determine its value.

3.6.1 Silaging

If being kept the material needs to be silaged / stored in an anaerobic environment to prevent oxygen from enabling it to degrade. Oxygen or water (hydrogen and oxygen) will cause nutrient loss, allowing the growth of aerobic bacteria which will cause degradation, resulting in little to no methane production when it is put through the AD process.

When processing in this way it is essential that it is done with speed and the material is kept fresh and not left to degrade in the air for too long. When undertaken for agriculture, the material would be cut one day, rowed up, collected / foraged the next. Silaging as a process is an art of its own and may be undertaken a number of ways. It will depend on the facilities on the site where you are storing your material as to which method you choose. If you are on or working with a nearby farm, many have existing silage pits which can be utilised. Another temporary way in which to store silage material would be the AgBag system. If silaged effectively, well sealed and oxygen kept from the material in can typically be kept for a number of years. Using the AgBag system, which provides a complete seal from the air, the material can be stored for up to 7 years. Having this capability provides continuity of feed and a contingency to cope with wet seasons, when material cannot be harvested.



Silage being made in a silage pit

4. Operator sustainability criteria

5. Plant location

5.1 Cost benefit analysis

6. Supply contracts

To supply existing set ups whether AD or CHP it is likely that there will be a need to set up a supply contract between the organisations involved. Whilst in principle this may seem straight forward, there are a number of factors to consider especially in relation to the key drivers for the management work. Supply contracts usually for the basis on which investment is secured for large scale plant development. As a result they will typically be a set period of time and for a minimum amount of material, so that the energy organisation can demonstrate continuity of feedstock supply. Before agreeing to such terms it would need to be ensured that material can be supplied each year without being detrimental to the site and compromising the conservation objectives.

6.1 Heads of terms

7. Payment

8. Further information and support

For further information and advice, please contact Sally Mills, Reserves Bioenergy Project manager for the RSPB:

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