Newtown Biomass Hub Proposal

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Introduction

The initial stimulus for this proposal is that Newtown Town Council has inherited 140 acres of green spaces from Powys County Council, and management of these green spaces results in a disposal problem for a considerable volume of green waste (mainly low-grade cut grass).

The options for disposing of this green waste are very limited, resulting it much going to land fill. This is a poor and expensive solution when we are being urged to reduce carbon emissions as much as possible.

It became apparent that there are many businesses and enterprises in Powys in a similar position. They produce organic waste but not in sufficient volume to justify investing in the means to process it in a carbon friendly way. Collectively, however, there would be sufficient to do something much more interesting and planet friendly with this resource.

This prompted this investigation into what could be done to aggregate organic waste from a variety of sources and come up with a solution that significantly reduces the impact on the climate and on the environment.

Carbon emissions are not the only environmental issue being addressed. Organic waste also contributes to air and water pollution all of which potentially can be reduced.

This document is a proposal for a solution that could be implemented in Newtown. This is only a broad-brush investigation but hopefully demonstrates sufficient promise that warrants these benefits and costs to be investigated more thoroughly.

Glossary and acronyms

AD	Anaerobic Digester
Digestate	Organic waste after digestion on an AD
GHG	Greenhouse gases
IPU	Intensive poultry unit
LCA	Life Cycle Analysis
STW	Sewage treatment plant

Policy background

The urgent need to tackle climate change and the intense and growing media coverage of this over the past couple of years should mean that there is little doubt in anybody's mind that we have to examine carefully how we process biomass and need to ensure that we do so in a way that minimises overall carbon emissions.

We have set out the policy drivers in detail in Appendix A. (The appendices are in a separate document file)

Resource availability

Biomass is bulky and expensive to transport over a long distance, so any solution has to work within very local distance constraints. A 10km (6 mile) radius has been used as a very approximate criterion for the distance that feedstock could be economically transported to be processed and this study has attempted to gather broad estimates of volumes and types of biomass material availability within this constraint.

Open Newtown presents one facet of a problem, their need to manage green spaces for the benefit of the environment and public enjoyment involves cutting the grass on municipal green spaces. There are other local enterprises with similar small-scale organic disposal problems that present biomass options. Rarely are these options explored to the point that the best possible use for them can be examined.

Below is a brief summary of the biomass resources currently identified in the Newtown area.

Sewage sludge

Hafren Dyfrdwy (HD) is the water utility covering the Newtown area, an area previously covered by Severn Trent. HD was formed in 2018 when Severn Trent was separated into separate English and Welsh utilities. HD remains within the Severn Trent group.

The Newtown Sewage Treatment Works (STW) is the largest within the HD area and generates about 350 tonnes (dry content) of sewage sludge per year.

In the past, there was an Anaerobic Digester (AD) plant at the Newtown site that processed this waste, but this has not operated for several years and has been decommissioned and dismantled.

Sewage sludge has a relatively low calorific value and an AD plant operating just on sewage sludge generates relatively low quantity of methane, making the AD plant relatively expensive to operate unless it is sufficiently large. The plant at Newtown proved to be uneconomic to maintain and this sludge is now transported to a Severn Trent AD plant in Shropshire for processing

The sludge is transported at an approximate 5% dry matter content, meaning that the volume transported is around 7000 tonnes, or around 300 lorries per year.

HD are keen for this processing to be carried out within Wales so would welcome a solution that avoided them transporting sludge to Shropshire. There is a potential revenue stream here by capturing some of the avoided costs that HD would no longer incur.

HD would also be willing for their site to be considered as a location for all or part of a more general biomass processing plant serving Newtown.

Poultry Litter

In Powys, there have been at least 75 planning applications for IPUs (intensive poultry units) granted since April 2017, and within 10km of Newtown there are at least 25 poultry sheds, mainly free-range egg producing sheds, ranging in size from 8,000 birds up to 180,000 birds.

In total, the number of birds being raised within this radius of Newtown is just over one million. (source: data tabulated from the list on https://www.brecon-and-radnor-cprw.wales/?page_id=44).

It is expected that more IPUs will be built, partly driven by the challenging economic situation for traditional farming in Mid Wales. Small family farms relying on traditional cattle and sheep are unable to generate a living wage for a farming family resulting in many farmers leaving the industry and taking employment elsewhere. Building an IPU is seen as one way that a small family farm can remain viable and independent. At present there is no barrier to additional planning applications for IPUs to be approved. The UK imports approximately 11% of the eggs consumed here so there is still considerable potential for more egg production before the market is saturated (source: www.egginfo.co.uk).

Free range hens typically produce about 1 tonne of litter per 10,000 birds per week (50 tonnes per year). For a quantity of one million birds, this equates to a total quantity of 5,000 tonnes per year.

Poultry litter can be used as a fertilizer, and much is spread on land for this purpose. Most of the poultry farms around Newtown spread some of the litter they produce on their own land, and sell any remainder to neighbours. Poultry litter contains all of the NPK components typical of the inorganic fertilizer that would typically be used on pasture in Mid Wales, but the nitrogen component is volatile and soluble and tends to be lost to atmosphere or leached in water so is not fully available to plants, hence farmers will often augment with a high nitrogen fertilizer. The volatile ammonia and nitrates are a serious form of water pollution.

Poultry litter is more bulky and less easy to handle than commercial fertilizer, which suppresses its value, and typically farmers receive around £5/tonne collected. For a typical 25 tonne lorry, this would only amount to £125 per lorry load, illustrating that the value would be dwarfed by the logistics of transporting it unless distances are very short.

One solution being experimented with is that of accelerated fermentation as a means of transforming the litter into a more convenient compost. This is the solution put forward by the commercial company Lohas Recycling that is proposing to building a facility close to Newtown to compost litter in this way, see https://lohasrecycling.co.uk/ and the press release at https://www.countytimes.co.uk/news/18901713.company-plans-chicken-waste-conversion-factory-newtown/.

This company claims that their process speeds up the natural composting process, reduces the carbon loss during the process, and reduces the emission of water and airborne pollutants. If this is to be used as part of the solution to the organic waste it will be important to demonstrate that the carbon LCA of this process matches that of other potential solutions that could be put forward.

Poultry litter does have a high calorific value (in contrast to sewage sludge, see above) and hence results in a high yield of gas from AD plant. It can usefully be blended with other lower energy feedstocks to produce a balanced AD “diet”. An advantage of putting litter through the AD process is that this does not prevent it from being used also as a fertilizer, most of the nutrients remain in the digestate and can be subsequently spread to land.

The impact of Nitrate Vulnerable Zones (NVZs)

There is an additional threat that in the near future, much of Wales may be declared as a Nitrate Vulnerable Zone (NVZ) and this will further restrict the amount of litter that can be spread to land. It is not clear yet what levels would be set for the NVZ and therefore not known what reduction it would mean for land spreading. Some form of restriction is however seen as inevitable and hence there is a need to reduce the spreading of raw litter onto land. More discussion about the impact of NVZs is contained in appendix B.

Ammonia

IPUs are also regarded as a source of air pollution through release of the gas ammonia. Once released into the atmosphere, ammonia dissolves into rainfall and then will affect biosystems with certain plant groups being particular susceptible to damage, e.g. lichens and fungi. Loss of these can the affect other species further up the food chain. The permissible level of airborne ammonia pollution is controlled by NRW.

Ammonia is a GHG, however its effect is not significant because it tends to remain for only a very short time in the atmosphere, as it is highly water soluble and is washed out in rain

Municipal grass cutting

Open Newtown is responsible for maintaining 140 acres of recreation space. This results in about 80 tonnes of low-grade hay being cut. Some has been disposed of as fodder, but much has had to be disposed of in landfill because no other destination could be found for it.

The biomass is produced all at one point in time at the end of the Summer, which potentially creates a storage and bottleneck issue.

More and more municipal green spaces are being managed for biodiversity, which generally means cutting and collecting grass rather than cutting and leaving, so it is likely that this volume will increase over time.

Grass cut from urban or rural recreation spaces is not harvested at its peak like hay or silage. The cut material is a mixture of grasses and small herbaceous plants. In some cases it is considered as a waste product which needs to be pre-treated before use. Contamination can be through litter, leachate from surrounding farmland, exposure to products of combustion from traffic and the road surface and through general usage including dog faeces.

Whilst low in cellulosic material, fresh green cut tends to be high in water soluble sugars and starches and are thus ideal for the AD process to generate heat and power.

Roadside verge cutting

A transformation of road verges has been going on since 2015. Before this date, standard practice was to cut verges up to 10 times a year, leaving the cut grass in place, which mulched down, increasing the nutrient levels in the soil, making the grass grow ever more vigorously and smothering out wild flowers.

In 2006, Powys County Council, the Montgomeryshire Wildlife Trust and the Mid and North Wales Trunk Road Agency conducted an operational trial to collect verge mowings from highway verges using a vacuum collection system connected to a flail mower head. The cuttings were treated by composting and by addition to an on-farm Anaerobic Digester at Bank Farm in Shropshire.-The results of this trial were encouraging in terms of biodiversity gains and in reducing operational costs.[1]

The idea was to gradually reduce the fertility of the verges by collecting the cut grass, rather than leaving it to decompose in situ. Collecting and removing the cut grass will gradually deplete the soil. This has two benefits, firstly it reduces the frequency that the grass needed cutting, (down to typically twice a year) which drastically reduces the cost of doing so, and also suppresses the growth of grass allowing a greater variety of plants including wild flowers to flourish which are otherwise unable to compete against grass in a high nutrient soil.

This practice is gradually being adopted by different local authorities and agencies. The trunk road agency that manages the trunk roads in Powys (North and Mid Wales Trunk Road Agency, or NMWTRA) has indicated that it intends to use cut and collect along the entire stretch of the A483 between Newtown and LLanymynech (23 miles) including areas of the new Newtown bypass.

Much of this is of course beyond the cost-effective limit of transporting to Newtown, but nevertheless much could be accommodated in a biomass hub in Newtown if one existed. NMWTRA would not have sufficient material in one location to make it economic for them to process this in dedicated facilities, so would need to find third party facilities to use.

NMWTRA have indicated that some of the cut grass could be used to distribute as “green hay” in other locations to spread the wild flower seed it contained, but the quantity that could be used for this purpose would be limited otherwise this would defeat the object of depleting the nutrient levels. Another option is to leave in heaps on land of low value, but as carbon and energy become more critical, this would not be regarded as a sustainable practice and would only be used if appropriate biomass processing facilities were not available within economic range.

[1] Living Highways Report Montgomeryshire Wildlife Trust. January 2006

In other local authority areas that are experimenting with this, the cut grass has been taken to the nearest commercial AD plant (e.g. Lincolnshire County Council). In Powys, this would be limited by two factors, the first is that there are not many commercial AD plants to choose from, and the second is that most commercial AD plant is tuned to the particular feedstock that the plant was designed around. Operators are reluctant to take alternative feedstock because of the danger of disrupting the delicate chemical balance within the AD plant. This has been the experience of Open Newtown in seeking to identify a destination for the grass cut from the municipal green spaces in Newtown and indeed, it has not been possible to find a commercial AD plant within 10km of Newtown that is willing to take municipal cut grass.

To estimate volumes, we will assume that the arisings from a 10km stretch of trunk road could be available to a biomass hub. If we also assume an average width of 4m is cut (2m each side) this amounts to an area of around 4 Ha. Assuming a yield of 5 tonnes per Ha, this indicates a volume of about 20 tonnes of biomass available from this source, subject to an agreement being made with the NMWTRA.

Non-trunk roads may also be included in this initiative, which would include a far higher mileage of road from which cuttings could arise, but discussions on this have not taken place yet. If all the roadside verges in Wales were treated in this way, there is potentially in excess of 40,000 tonnes of roadside verge arisings available.[2]

Cut grass composition

Roadside verge material can be a wide variety of species depending on the nature of the management. Often they are comprised of weedy vegetation such as nettles and coarse grasses. The material may be contaminated with run-off from the road surface and any wear associated with traffic movement and the products of combustion from fossil fuels. There may need to be mitigation steps to be re-integrated into composting routes if entering the food chain.

Other Green waste

Domestic and commercial green waste in Powys is collected in a variety of other forms. Householders can request a “green bin” for garden waste which is collected by the council and taken to the Bryn Posteg landfill site operated by Potter Waste Management. The HWRCs (household waste recycling centres) in Newtown and Welshpool also take in both domestic and commercial green waste which is also then taken to Bryn Posteg to be composted there.

Taking this waste that originates in Newtown or Welshpool to a site closer to Newtown would reduce the transport miles and potentially be a more carbon efficient solution, but this contract is held by Potters and hence Open Newtown has no control over this feedstock. The material closest to Newtown could be processed at a local biomass hub rather than be transported the greater distance to Bryn Posteg, but this is still subject to negotiation with Potters.

Food waste

The contract for processing domestic food waste collected from the kerbside is currently held by Agrivert in a X year contract with the county council. No assumption has been therefore made for this to be available to the biomass hub. It would be the intention to make sure that any system were designed to take food waste in the future so that the option of taking food waste could be accepted if this became possible. (As a point of interest, the municipal sewage treatment plant at Baden Baden in Germany, one of the partners with Cwm Harry Land Trust in the development of the IFBB process equipment installations, produces a

[2] COMBINE- Biomass feedstock analysis in Wales Cwm Harry Land Trust / Bangor University 2015

high-energy slurry from municipal food waste and ensiled green waste to add to the sewage sludge digesters at its plant.)

Optimising carbon outcomes

One of the main points of this exercise is to take a slightly different approach to identifying the right solution than much of the biomass feasibility work done previously.

Over the past 10 years, there has been a great deal of commercial activity in building AD plants to process a range of materials including animal manure and slurry, human sewage, energy crops, food waste and garden waste. The main driver for this has been the Feed in Tariff and Renewable Obligation Certificate that provided a financial incentive for organic waste to be processed this way.

In most cases, the financial incentive also roughly aligns with the desirable carbon outcomes (hence the reason for creating the financial incentives) but as more is understood about the chemistry of organic waste processing and how carbon circulates through the various processes, it is time for a fresh examination of the way that we process organic waste to make sure that the solutions we have been adopting are still the right ones in every case. It may be that particular types of biomass are best treated in very specific ways.

The purpose of carrying out the work behind this document has been to come up with some suggested solutions for optimal processing of the biomass wastes around Newtown, and to pose some questions about what happens to the carbon in the organic waste.

What needs to happen next is for these suggestions to be subjected to further scientific scrutiny to establish the most appropriate solution for Newtown.

During the course of these investigations, a number of key considerations or questions have emerged which are worth exploring further here. These include:

Digestion of waste with low energy content.

We know that some organic matter yields more methane in an AD plant than others. Feedstocks that have high yield include chicken litter and food waste, whereas feedstocks that produce low gas yields include cattle slurry and human sewage.

The reason for this variation is that the purpose of an animals digestion system is to extract energy from food, so organic matter after being digested by an animal (or human) has a lower calorific value than before being digested. Humans and cattle have fairly efficient digestion systems so extract quite a large proportion of the calorific value in the food leaving less in the resulting slurry or sewage.

[Ed: why is poultry litter so high in energy then? Is the digestive system of a chicken less efficient than a human or cow?]

What this means is that an AD plant run on food waste or chicken litter tends to generate a lot of gas and hence a lot of electricity for export to the grid. AD plant fed on slurry or sewage generates less gas. In many cases, a large proportion of the extracted energy is used up in parasitic loads for instance heating the AD vessel or in pumps and motors, leaving very little if any for export to the grid.

Often AD plants that processes slurry are “boosted” by addition of higher energy feedstock. But is this “throwing good money after bad”. The Feed in Tariff tends to skew the results here. If a high subsidy is paid on the energy generated from the plant, but not on all the energy required to operate the plant, what is actually a very marginal carbon benefit can become financially attractive.

This therefore raises the question: For low energy content feedstock, where little surplus electricity is generated, is the carbon LCA of processing sewage in an AD plant any different from what would have occurred if the waste had been for instance allowed to decompose aerobically (ignoring pathogen issues for the moment)?

If this is the case, is there a better way of treating these low energy content materials that has a better carbon outcome than using AD?

Leakage of methane in the AD process

Methane is a very potent GHG, about 20 times more potent than carbon dioxide, so any small leakage of methane from the process potentially makes the AD solution worse overall (w.r.t. carbon LCA) than a solution that did not involve methane (e.g. aerobic composting). So it is important to quantify how much methane may escape from a real world AD installation.

This leakage could happen in many ways, for instance, leakage in the vessel or plumbing, but also, and probably more significant, methane that is released from the digestate after it is ejected from the main vessel.

There is a temptation in commercial AD plant to eject the digestate before it is fully exhausted, because from a financial point of view, more revenue can be generated by completing a cycle more rapidly and enabling greater throughput of feedstock, than extracting the maximum amount of methane from every bit of feedstock.

What happens to the carbon once it is spread to land

Once the digestate is ejected from the AD vessel, it is typically spread to land as a soil improver. There will still be some carbon compounds in this digestate. The carbon content of digestate is typically between 28 and 47% of the dry matter content[3] . This carbon is then spread on land and incorporated into the soil, but further decomposition over time is likely meaning that part of this remaining carbon is likely to return to the atmosphere as CO_2 or CH_4 over a period of years.

Understanding the long-term outcomes of compost vs AD digestate over this timescale when spread on land is important in understanding whether AD or a different process would have the best overall carbon and carbon LCA outcomes.

Capture of Nitrogen

Many organic waste streams also contain nitrogen compounds that can be both harmful and beneficial. Harmful consequences can be nitrate pollution in groundwater causing algal blooms and depleting oxygen levels in watercourse. Beneficial consequences are if the nitrogen can be taken advantage of as a fertilizer.

One priority for organic waste treatment, in addition to the issue of GHGs, is therefore to maximise the benefit and minimise the harm caused by nitrogen compounds. Current practice is for the regulatory system to set limits on harmful effects, but to allow any activity to take place as long as these limits are not breached. This does not incentives the exploration of more beneficial solutions.

Some innovation is happening. The possibilities of using processes centred around Struvite are receiving some attention, especially in the processing of sewage sludge as a way of locking nitrogen into slow release forms, reducing harmful leaching and making more available for plants to use.

Our proposals suggest more investigation is carried out into the potential for struvite as a mechanism in Newtown to ensure that nitrogen outcomes are optimised in addition to carbon outcomes.

[3] Möller, K. Effects of anaerobic digestion on soil carbon and nitrogen turnover, N emissions, and soil biological activity. A review. *Agron. Sustain. Dev.* **35,** 1021–1041 (2015). https://doi.org/10.1007/s13593-015-0284-3

The same issue occurs with poultry litter and experimental work has been carried out at Bangor University and others to show how struvite can be used within a process to recover fertilizer minerals from chicken litter. This appears to offer very promising opportunities and needs further investigation into whether this could be part of a holistic solution for Newtown. [4]

The role of Biochar or Hydrochar

There is much interest at present in the use of biochar or hydrochar as a means of locking carbon and increasing soil fertility, e.g. Poultry litter hydrochar as an amendment for sandy soil (2020) [5] and Comparative study of poultry litter and poultry litter biochar application in the soil for plant growth (2020)[6]. These solutions need to be investigated in particular to explore the evidence for long term sequestration of carbon.

Exploration of options for Newtown

Three possible scenarios are proposed for Newtown and we are suggesting that these need to be explored in more depth. These scenarios are, in summary, described below and a more detailed analysis is provided in Appendix F. One aim of the different examples is to be able to compare how the LCA differs, particularly between an AD based scenario and a non-AD based scenario, to confirm whether AD genuinely does give the best carbon as well as financial outcome as seems to be commonly assumed.

Scenario 1

This scenario basically comprises:

- A new AD plant at the Newtown STW to process sewage sludge
- A new biomass processing site (site 2) built close to Newtown to receive poultry litter, cut grass and other green waste
- Energy rich "liquor" is extracted from this other waste, primarily from the poultry litter. This liquor is transported to the STW and added to the sewage sludge to boost the methane yield and make the AD plant self-sufficient or in energy or energy positive.
- The AD digestate would be processed to capture Nitrogen and Phosphorus using Struvite or other similar technology.
- Other material at site 2 is sorted and blended. Woody material is pyrolysed and non-woody material is composted in a rotary continuous feed composting unit.

A key element of this solution is to import some high energy content material into the STW site to make the AD plant perform better (historically, operating the AD on sewage sludge alone results in low gas yield and a non-viable plant).

It would be important not to bring in too much bulky material that would add volume to the digestate, because once mixed with the sewage sludge, the total volume would have to be treated in the same restricted way as sewage sludge which would make the ultimate disposal more difficult and more expensive.

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[4] Synthesis and characterization of struvite derived from poultry manure as a mineral fertilizer, Ioná Recha, Marcos Kamogawaa, Davey Jones, Paulo Pavinatoa, (NOTE: Davey Jones is at Bangor University)

[5] Poultry litter hydrochar as an amendment for sandy soils, https://doi.org/10.1016/j.jenvman.2020.110959, Journal of Environmental Management Volume 271, 1 October 2020, 110959

[6] Comparative study of poultry litter and poultry litter biochar application in the soil for plant growth (October 2020 SN Applied Sciences 2)

The proposal is to make an energy rich liquor by washing poultry litter in water, separating the water soluble sugars from the non-soluble fibrous content, as demonstrated by the Interreg REDIRECT project[7]. The sugars are high in energy which would boost the gas yield of the AD without increasing the bulk of the digestate and hence would not exacerbate the problem of disposing of the sewage digestate.

Both Sewage Sludge and Poultry Litter contain high levels of Nitrogen and Phosphorus, which cause leaching problems when applied to the ground. There are various struvite based technologies discussed above for locking these into less water soluble forms, and we would investigate which of these could be the most effective way of reducing the problem of nitrate leaching.

Grit can be a problem with AD. This can build up in the digestion vessel and is not expelled with the digestate. Various designs of AD plant has been designed to overcome this problem, for instance the plant developed by Fre-Energy (http://www.fre-energy.co.uk/). A plant of this design would be incorporated to overcome any problems with grit and stones.

The fibrous component would be either pyrolyzed or composted on site 2, together with other blended material.

Composting would be carried out in a controlled environment. Our suggestion is that a rotary composter is constructed, similar in design but of larger scale than the "Rocket" composter[8].

Scenario 2

This scenario avoids the use of Anaerobic Digestion. The intention is to enable a comparison in outcomes between an AD and non-AD solution.

The scenario would comprise the following:

- On the STW site, the sewage sludge would be dried and pyrolyzed to form biochar. This is a recognised processing method for sewage sludge[9]. The process would include a precipitator to form and remove Struvite which would allow the nitrogen content to be salvaged from the sewage and used as fertilizer.
- A new site (site 2) would be used to aggregate and process other forms of organic waste.
- Some woody material from site 2 would be prepared as fuel and sent to the STW to be used as process heat to help the drying and pyrolysis process.
- Site 2 would aggregate and blend the remaining organic waste (including the poultry litter) via a variety of processes including compost and pyrolysis to create a variety of value added products such as compost, biochar, fuel etc.
- The process proposed by Lohas (for pelletising chicken litter) would be analysed to compare the outcome against other options.

Scenario 3

This scenario is one in which AD is used to maximise the yield of methane, and hence electricity from the waste available. The scenario would comprise:

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[7] https://www.nweurope.eu/projects/project-search/regional-development-and-integration-of-unused-biomass-wastes-as-resources-for-circular-products-and-economic-transformation-re-direct/

[8] https://www.tidyplanet.co.uk/our-products/the-rocket/

[9] http://www.biogreen-energy.com/pyrolysis-applications/sludge-pyrolysis/

- A new site (site 2) which would be created to act as a biomass hub. All organic waste, other than the sewage sludge from the STW, would be brought to this site.
- Site 2 would contain an AD plant based on the design by Fre-Energy i.e. to have grit removal facilities. It would also incorporate N and P recover in some form e.g. by Struvite precipitation.
- The waste aggregated at site 2 would be processed either by the AD plant or by composting/pyrolysis according to whichever results in the best carbon outcome. This is likely to mean (subject to confirmation by more research) that the AD would process the poultry litter, food waste (if any), and sugar rich grasses. Woody waste would be processed into fuel or pyrolyzed to form biochar, and any residual would be composted.
- Sewage sludge would remain on the STW site. The sludge would be processed by pyrolysis and converted to biochar. Some woody waste would be transported from site 2 to provide process heat for the pyrolysis process.

The advantage of this approach is that each different type of organic waste would be examined to determine what process would produce the best carbon outcomes.

Products and services

Key to the success of this biomass hub commercial success would be to maximise the value of all the products and services that could be produced from the operation. The following products and services have been identified as potentially generated by a biomass hub. Part of the feasibility work would be to identify markets and assign value to all the products that could be produced.

Potential added value products and services:

Energy

- Gas (AD) leading to either direct gas injection in the grid, or electricity for direct sale of export to the grid
- Logs, briquettes & pellets. These may not be suitable for domestic boilers that require low ash content fuel, but could be suitable for commercial boilers and domestic log stoves.

Fertilizer and soil improver

- High grade fertilizer can be produced from some sources of organic waste, e.g. raw poultry litter has only low value as fertilizer because it is bulky hard to store or process, but if this is dried and turned into pellets, it becomes more valuable and can be sold at a premium price on the retail market.
- There is also the potential to manufacture high value commercial fertilizer by extracting certain minerals such as Struvite from waste such as poultry litter and sewage sludge.
- Soil improver/compost

Woody & Lignateous material

- As a packaging material (compressed into fruit punnets or egg boxes)

Biochar and Activated Charcoal

- As an animal feed additive
- As a substrate/soil conditioner, blended compost
- Nutrient locking
- Odour control
- Contamination filter/waste water treatment & recovery
- Other (cat litter, dog biscuit additive, building material, bbq & metalworking)

Services

- Carbon locking / carbon credits
- Nature reserve management
- Problem material management (road leaf sweepings / leaf litter, verge side biomass)
- Contract landscaping
- Waste stream mitigation (avoiding composting or landspread)
- Invasive species control

Waste heat

Various processes (composting, AD) can produce waste heat that could for instance be used for space heating or for heating of greenhouses / polytunnels. In addition, some low-grade biomass could be incinerated to produce heat if additional higher-grade heat Further work

Carbon life cycle analysis

By doing a carbon life cycle analysis of scenarios 1, 2 and 3, it would be possible to see which approach is actually a better solution for the climate.

A suitable authority would be engaged to research and advise on the carbon life cycle analysis of each of the options to be explored. CREST (Chester University) have been consulted and have the expertise to carry out this LCA but other authorities would be consulted also.

The key question to ask is "If we start with an amount of biomass that contains 1kg of carbon, where will that carbon end up, and in what form, in 1 year, 10 years 20 years etc?"

Associated to this is the secondary question, which is, "If we create any surplus energy in the form of gas or electricity or biomass fuel, how much GHG emission would be prevented by avoiding the need to burn fossil fuels?"

Only by answering these two questions for each of the scenarios we pose, we can determine which is the most suitable solution for Newtown that optimises the carbon outcomes while being financially viable.

More detail on the way in which Carbon life cycle analysis would be carried out is contained in Appendix G.

Partners

The following organisations have been consulted during the preparation of this report and will be asked to review this paper.

Partner	Contact
Hafren Dyfrdwy	Pat Spain
Farming connect	Owain Pugh
North and Mid Wales Trunk Road Agency	Hannah Jones
Open Newtown	Gary Mitchell
Fre-Energy	Denise Nicholls

CREST (Centre for Research into Environmental Science & Technology)	Jane Yardley
E4Environment	Mandy Stoker

Commissioning of a full feasibility study

Our request is that a full feasibility study is carried out to establish the viability of the proposed organics hub and to investigate in more detail the best technological solution to the problem.

This feasibility study will refine the most appropriate technological solution and once that is done, carry out all other necessary work to achieve a fully consented project.

The main questions that this feasibility study would address are:

1. What combination of processes would create organics solution for Newtown, balancing finance against the full 20+ year Carbon life cycle analysis.
2. How do AD based solutions compare against non-AD solutions for the different feedstocks that are generated around Newtown.
3. How can revenue be maximised by adding value to products and services.
4. Is there a viable business model for operating such an organics hub in Newtown.

The elements of this work that are require are anticipated to be:

Stage 1 components:

	Detail	Estimated budget	Sourced from
Waste regulations	Identify all relevant waste regulations and ensure that the proposal is fully compliant	£5,000?	
Verification of feedstock availability	Obtain adequate assurance from all feedstock providers that the site will be guarantee adequate feedstock.	Undertaken by project manager	
Detailed assessment of capital investment required	Obtain detailed quotations for all capital expenditure that would be required to establish the operation	Undertaken by project manager	
Detailed assessment of operational costs and income and prepare a detailed financial projection.	Gather evidence to enable a full financial projection to be calculated.	£5,000	Various sources e.g. E4Environment
Carbon life cycle analysis	Carry out a carbon life cycle analysis of the options in the proposal to inform the decision on the technology to install.	£10,000?	Get quote from CREST or USW?
Assessment of the potential of an intensive food production facility to be developed alongside the biomass hub.	Many of the by-products of the biomass hub will be beneficial for food growing e.g. compost, low grade heat, CO_2 enriched air. This could make a combined biomass hub and intensive food production plant a viable combination.	£5,000	
Project management (PM)	Employment of a PM 2.5 days per week for 1 year.	£25,000?	
Project oversight	Project director, 0.5 days per week	£7,000	

Stage 2 components:

Further development work if the feasibility study is positive.

	Detail	Estimated budget	

Site identification	Identification of possible sites compatible with requirements for transport, electrical connection, proximity to land suitable for food growing, minimisation of potential problem with odour issues.	£5,000	Input from various sources
Legal permissions	Draft head of terms for land permissions, agreement on rent or other ongoing costs.	£10,000	
Planning permission	Prepare and submit a full planning application which will include examination of transport, flooding, visual impact, odour, noise, waste regulation etc issues.	£35,000 including LA fees and consultant report.	Get quote from E4Environment

Recommendation:

It is recommended that funding is sought to complete the stage 1 tasks which will complete the feasibility work for establishment of a biomass hub in Newtown.

The cost for this is anticipated to be in the region of £60,000.