Notes on Smaller On-site Biogas Plants for BEIS

With the recent events in Ukraine and the rise in fuel prices, concern about food and energy security must raise questions about the need for support for onsite industrial AD in the agri-food sector.

There is potential to increase biogas output based on a range of industrial and farming bio-residues that have not yet been fully accessed. After the demise of the RHI there is no support for smaller off-grid biogas production. This is skewing the AD sector towards larger plants rather than on-site ones like BrewDog, based on treating brewing process residues at the site – see infographic below.

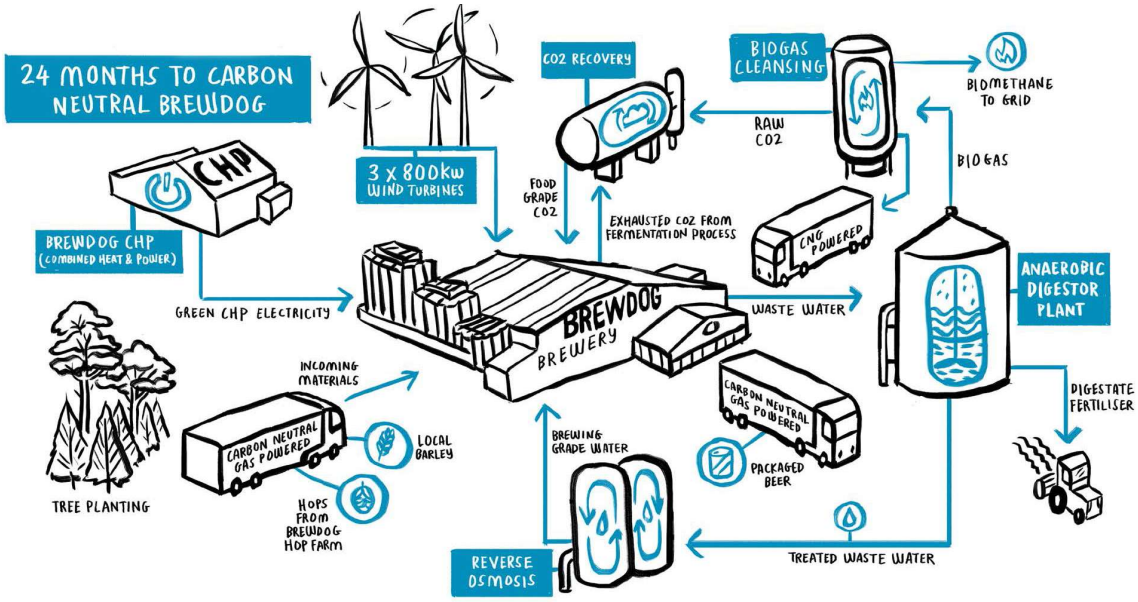
One of the main limitations of the Green Gas Support Scheme which (despite multiple comments and representations to BEIS officials) excludes smaller off-grid biogas plants, is that it is encouraging the feeding of larger AD plants with more purpose crops at a time of heightened concerns about global grain supplies, re-igniting the food or fuel debate. The omission needs to be addressed.

If the UK is serious about reducing fossil fuel use in providing heat and as transport fuel, it does not make sense to limit the supply and use of biogas (or indeed biomethane) to sites connected to the gas grid. There is potential for multiple smaller on-farm AD plants to supply rural clean energy and the only adoption ready diesel replacement for trucks and off-road vehicles is biomethane (BioCNG).

When discussing gas fuels to replace diesel, BioCNG is often mentioned alongside BioLNG but this is not a valid comparison. Given the high gas prices in the current market, there must be a question over the long-term viability of importing bio-LNG (there are no plans for significant UK production at present), when the UK can produce significant volumes of BioCNG by using existing biogas plants.

Given other concerns over the use of BioLNG as fuel, perhaps the UK should concentrate on boosting BioCNG output for heat networks and diesel replacement, including converting off-grid biogas plants to increase biomethane to help service demand for gas fuel in rural areas, as well as new plants.

Infographic Produced by BrewDog – showing AD as part of their ambitious decarbonisation plans



This approach can be mirrored across the food and beverage sector (inc. other craft breweries) if the appropriate support mechanisms were in place (if not in the GGSS, a separate scheme – see below).

Justification for On-site AD

As part of the challenge of decarbonisation in the agri-food sector (and also pharmaceuticals) there is a significant opportunity for the development of local or on-site AD plants to convert residues and wastes from production activities into biogas or biomethane. We define on-site AD plants as plants located on or close to an industrial site (or several co-located sites) that will only process feedstocks from that site (or sites) and can use some of the biogas produced to replace fossil fuels on that site.

The focus should be on mobilising wastes from production processes. While there may be a case for including purpose grown crops in smaller (sub 1MWth) on-farm AD plants, combined with manures or wastes (e.g. crop / silage residues), greater use of crop feedstocks may not be desirable. Further expansion of crop AD will impact the ability of arable farms to prioritise cereals orother food crops.

Farm AD plants could be encouraged to process wastes from local food and beverage sites and well as local food wastes, as is the case on smaller farm plants in Germany (but currently discouraged by the EA). Hence, aside from the need to address the failings of the GGSS in the mid-term review, BEIS should work with DEFRA and DtF (inc. support for rural fuel supplies to replace Red Diesel) to build an enhanced off-grid smaller AD sector, based on residues and wastes rather than primarily crops.

With the termination of the FIT and RHI, the UK AD sector has focused on the GGSS. This is limiting the scope for waste / residue based industrial AD, which is the third leg of the AD sector, alongside merchant food waste AD (which is nearing over capacity) and on farm AD, which is almost entirely focused on crop-based systems (given the lack of support for smaller scale AD on livestock farms).

Opportunities for smaller on-site biogas plants have been undermined due to long-term reluctance within BEIS to support such plants (as well as the way that the regulatory regime bears more heavily on smaller plants). This has led to the demise of a number of biogas technology providers in recent years. There is a need for a new generation of AD companies such as WASE see Home - Unlocking the power of waste – WASE - developing modular systems more suited to smaller applications. Or low-cost solutions for smaller farms such as covered lagoons, which produce limited gas output.

Existing AD plants that are seeking to produce gas for HGV fuel should also be encouraged. Building multiple smaller biogas plants that can produce clean energy in rural areas could make a significant contribution to efforts to decarbonise the agri-food sector, as indicated in the RASE 'Farm of the Future Report' - Reports - RASE. Multiple smaller biogas plants in rural areas will make a significant, long-term contribution to rural energy demand, with decentralised supplies for heating and fuel.

Given the various pressures on the smaller (on-site) AD sector, it is perhaps surprising that there are multiple opportunities for more smaller scale and off-grid biogas plants on industrial sites, some of which Foodchains is aware of – perhaps reflecting industry decarbonisation needs. These include:

- **Malton and Norton:** this is a community AD plant being developed to service the local food sector in this north Yorkshire market town, by a community interest company (CIC), with the support of NNFCC. The circa 1MWth biogas site is seeking planning permission and will be built in 2023. It has had some grant funding and will raise funding from a range of investors.
- **BASF Littlehampton:** this site produces nematodes (chemical-free pest control) for crops in glasshouses, in a process similar to small scale distillation. Residual process liquors are suited to onsite AD and the company is in the process of securing planning permission for a small-scale modular biogas plant that will produce less than 100kWth for use on the factory site.
- **Hepworth Brewery:** this craft brewery in Sussex is running trials of an innovative, modular British biogas system. This lower-cost containerised, modular system (built off site) is being developed by WASE (see above). It can be deployed on other craft brewery sites (they have another brewery project in Bristol). This project will be viable based on-site conditions but with support more craft breweries will be able to look at reducing their carbon footprint.

- **Abbey Ecosse Site:** this project (sub 500kWth) - on a remote industrial site near Dounreay (Caithness) is being constructed. Fed with pot ale from a nearby distillery, it will receive the RHI (March 2023 extension). It will provide heat and power (with a heat network across the site) and may include converting biogas to BioCNG to fuel local trucks. The site will include electric charging (linked to wind generation) on the Scotland's North Coast 500 tourist route. Such on-site plants could be replicated on remoter mixed industrial sites across the UK.

- **Islay Distilleries:** there are many smaller UK distilleries that could use biogas to replace fossil fuels. This includes multiple distilleries on the Island of Islay. They are totally reliant on fossil fuels and have issues with pot ale disposal. There would be scope for several AD plants that service more than one distillery - but support is needed to initiate the project. Opportunities also include remoter mainland distilleries that need to replace fossil fuels (e.g. Ben Nevis).

- **Industrial project:** a processor of animal proteins into a range of food / petfood ingredients is looking at on-site AD for liquid processing residues to replace natural gas in its boilers. The digestion of animal by-products is well regulated but AD is a good way to achieve 'end of waste'. This on-site biogas project could be viable based on disposal cost savings but may not be large enough to justify the added costs of biomethane upgrade. Even for on-site gas use there is a need for support to mobilise such feedstocks into the bioenergy market.

Also, there is an opportunity to develop more on farm AD plants to supply clean heat / tractor fuel:

- **Grahams Dairy:** fatty milk process residues are suited to AD (e.g. BV Dairy project), including for farm cheesemaking sites (several are re-looking at AD). In Scotland, Grahams are installing an AD plant for both cow slurry and whey from cheesemaking. It is unlikely that the plant build will meet the RHI deadline and it is too small for the GGSS. Such plants deserve some support as the gas will replace natural gas in the creamery and will be compressed for use as HGV fuel (with RTFCs).

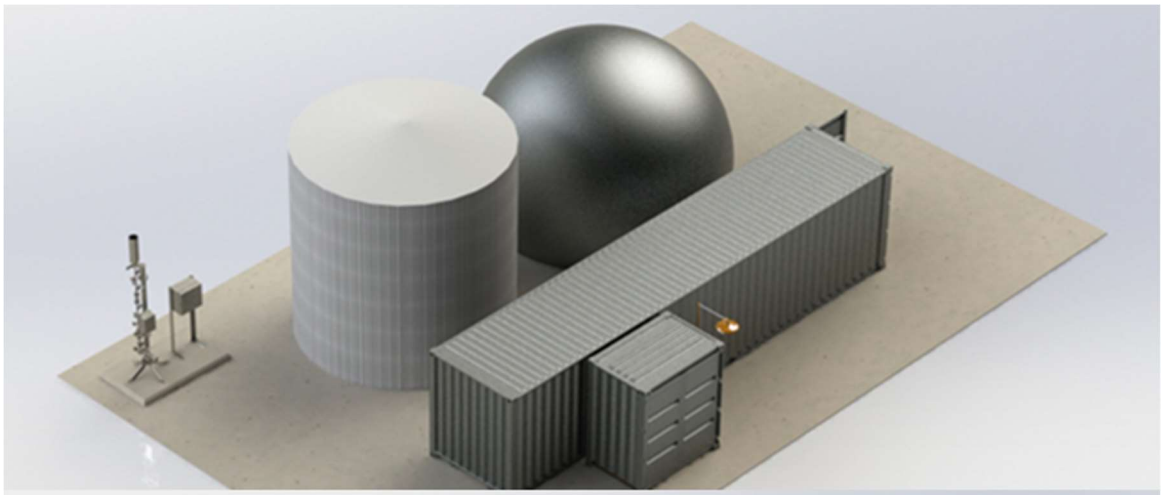
- **Farm AD Somerset**: This existing slurry fed AD site has been operational for 5 years but will require additional investment when it is acquired by the farmer on who's land it was built. Although it has not generated the returns to satisfy the investment fund that runs the site, it shows that farm AD without purpose grown crops can be viable if it is run and owned by the farmer. Farmers need support that reflects the environment protection benefits they offer.

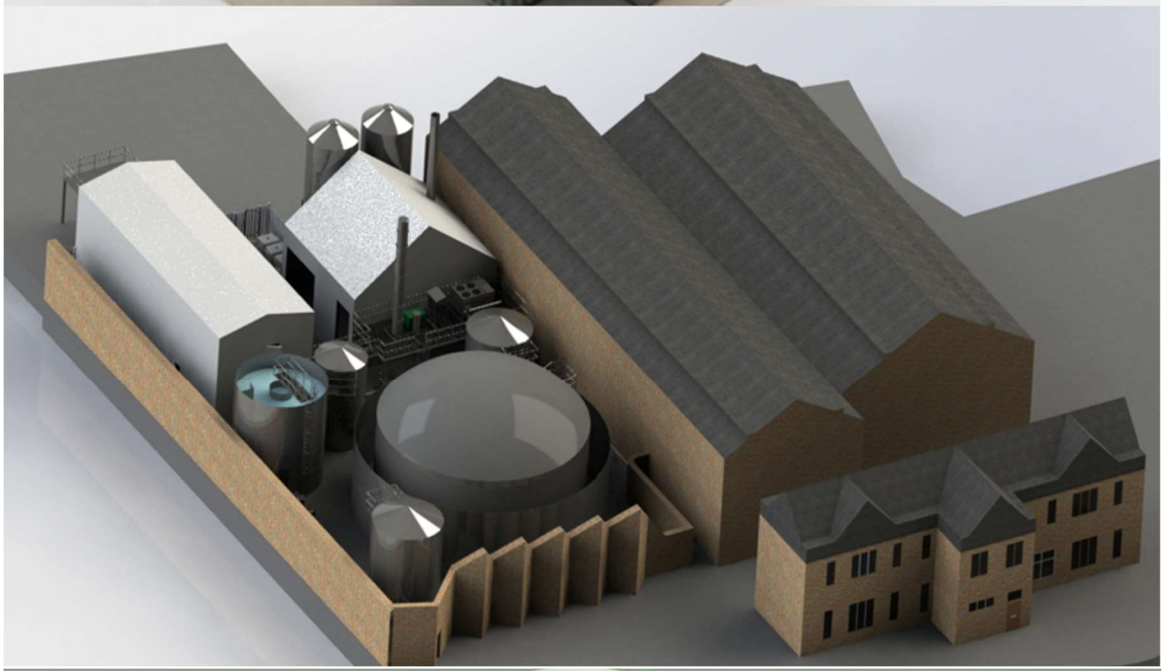
- **Farm AD Ayrshire:** This large family farm in southern Ayrshire plans to invest in AD to reduce its carbon footprint and environmental impact, alongside solar and biomass energy. Remote to the gas grid, it will treat manures and residues on the farm to supply heat and power, plus gas fuel for local trucks and tractors. Such projects can replace fossil fuels in remote areas but need incentive or grant support if they are to be widely adopted on smaller dairy farms.

- **Farm AD Wiltshire:** This arable estate is looking at AD for a specific solution involving heat and power supply to business premises, as well as the supply of BioCNG to replace diesel in vehicles that use the site. It is likely to be treating a mix of brewery waste, other feedstocks and some maize silage. It will be linked to other on farm energy supplies and as with other farm AD plants could provide a new source of income, while reducing carbon emissions.

Hence, there are opportunities to develop smaller AD on farms if BEIS and DEFRA can find a method of support for the benefits of on-site farm AD, that include reduced pollution risk (not the case with large crop AD), improved fertility and soil health and on-farm energy use. We also need to find ways to encourage more food processors to consider investing in AD to help reduce their emissions. This is addressed in the next section and we hope to stimulate discussion about possible support options.

The images below show designs for smaller scale biogas plants that have not been built in the past few years, partly because the GGSS does not encompass support for such smaller on-site plants.





Funding for On-site Biogas Plants

Exclusion from the GGSS for smaller scale or on-site biogas plants has curtailed recent investment in new biogas plants. BrewDog's on-site AD project is one of the last to qualify for the RHI. Some, such as Abbey Ecosse, will meet the extended deadline. However, given the need to curb rural emissions (inc. methane – post COP26), BEIS and DEFRA do not seem to have a plan to boost rural bio-energy.

There may be a number of ways that BEIS could explore to boost support for smaller and off-grid biogas plants, while also seeking to ensure good value for money for the taxpayer. These include:

- **Incentives:** the RHI and FIT have worked well but have also helped distort the biogas sector to larger plants. Also, the schemes have increasingly been distorted against smaller plants, under 1MWhr thermal output. Most on-site farm and factory plants will be under this level and hence unsuited to biomethane grid injection. Given the exclusion of off-grid plants from the GGSS, a case could be made for an incentive scheme for new sub 1MWth biogas plants.
- **Capital Grants:** it may be possible to work with existing grant schemes such as the industrial energy transformation fund (IEFT) but based on experience with the Scottish SEITF, few AD plants are being funded. It is unclear whether any biogas projects have been submitted to or funded by IETF. There might be a case for a agri-food specific biogas / biomethane funding programme within the IETF or through the regional Net Zero Hubs (the Midlands Hub was a funder of the RASE report), that could support farm and agri-food bioenergy in their region.
- **Soft loans:** unlike AD developers, businesses (inc. farms) have other demands on capital for investment. Hence ROI/payback are crucial - for some, over 20%. A cost-effective option may be to set up a 'fund' to provide soft loans (maybe with a 50% or £500k limit) to help co-fund bioenergy projects linked to agri-food decarbonisation. Perhaps this could be set up with a funder like NFU Mutual (for farms) or by working with the Net Zero hubs or WRAP. Once set up, if loans are limited to under 5 years, funds may be used for successive projects.
- **Innovation:** in the past, through bodies like WRAP, there have been funding competitions to support innovative projects (e.g. BV Dairy). This could be repeated but with a focus on use of biogas for rural heating projects or for vehicle fuel supply (i.e. rural diesel replacement). Incidentally, it is bizarre that agricultural vehicles are excluded from DTF funding activity for innovation on novel fuels to replace diesel in other off-road sectors like construction.
- **Levelling Up:** Is there an opportunity to assist businesses that want to invest in bioenergy under the levelling-up agenda? If funding was available under regional development policy for investment in decarbonisation for rural areas (to help low carbon technology adoption) this could be channelled through the Net Zero Hubs or local enterprise partnerships (LEPs) – to support plans to stimulate smaller scale rural and industrial decarbonisation projects.

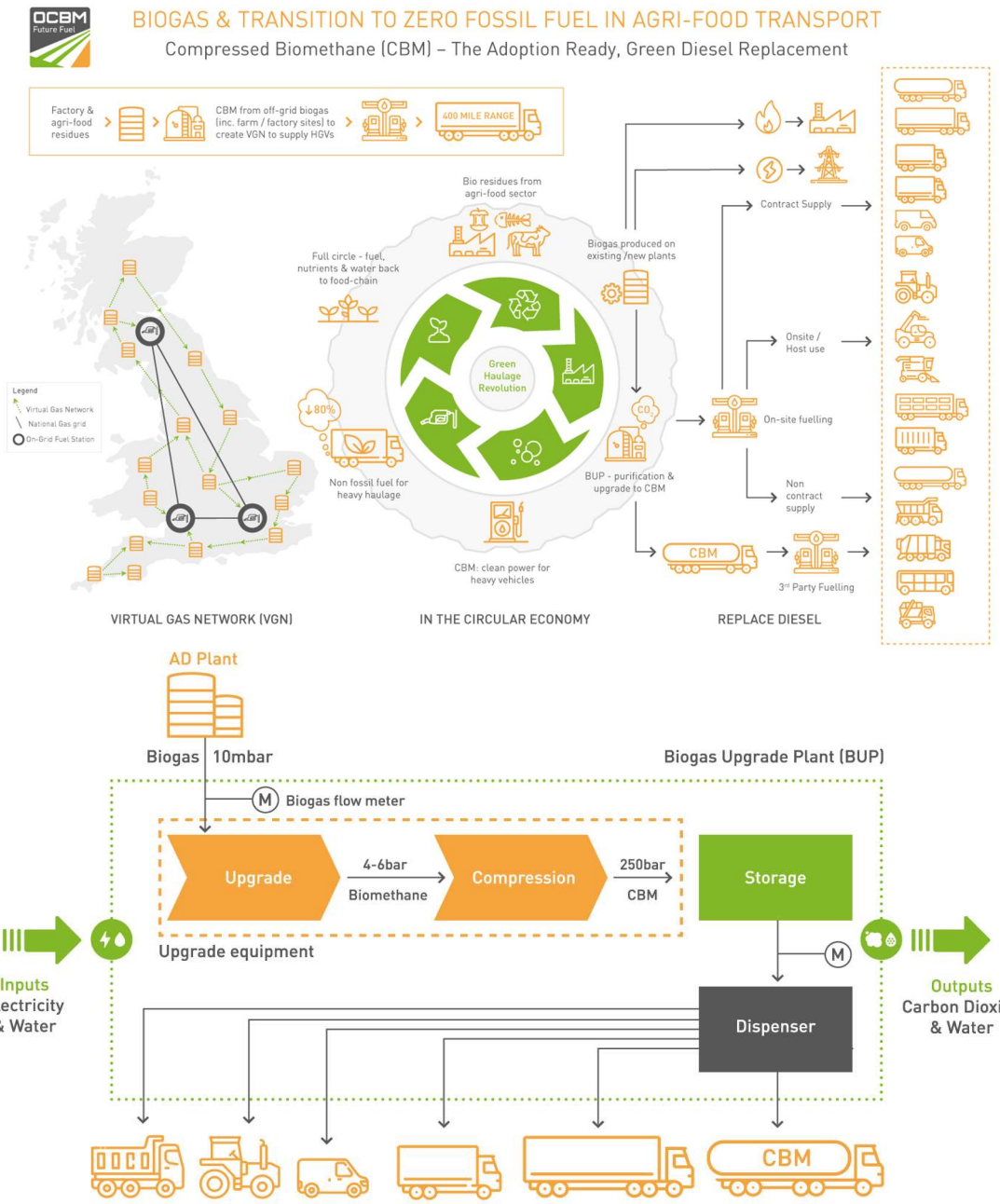
These ideas could be explored, as part of addressing future low carbon heat and fuel supplies in rural Britain. In addition, the ability of existing AD plants to gradually switch from power supply to the use of off-gird biomethane for rural heating and the supply of clean fuel for agri-food product transport. BioCNG offers a viable rural fuel supply solution, based on developing a cost-effective network of on-site, green gas refineries, on existing or new biogas site. This will facilitate early diesel replacement.

Evolution of Off-grid Biogas Plants

Farm and on-site AD should have a major role to play in decarbonising the agri-food sector, making better use of bio-wastes and residues to produce fuel for heating and diesel replacement. Access to affordable, pollution-free, non-fossil fuel from existing AD plants will boost haulage decarbonisation.

BioCNG sales into the transport sector receive support under the government's RTFO scheme. The RTFC value is market driven, and if obligated suppliers are unable to reach their annual blending target, they pay a buyout price. The RTFC price has been over 30p/litre for the past year or more.

There is scope for BioCNG produced off-grid to service factory and farm sites not linked to the gas grid. Innovation support would encourage such investment. The graphics below show how it would be possible to create a rural low carbon fuel network, developing an off-grid gas fuel supply chain.



The focus of diesel replacement in heavy vehicles should be on the transition to gas fuels, including hydrogen, over the next 25 years. However, compressed biomethane (BioCNG or CBM) is the only adoption-ready, diesel replacement for heavy haulage and farm vehicles. It is deployable now, in advance of high-power batteries or green hydrogen solutions becoming more widely available.

HGV operators need to adjust vehicle replacement plans while avoiding inflationary cost. Policy must take account of comments in the 2020 Cadent report (by Element Energy) - Green gas HGVs are key to net zero says new report | Cadent (cadentgas.com). The report distinguishes between immediate investment in BioCNG for HGVs (applies to non-road vehicles) rather than wait for other solutions:

- Rapid deployment of biomethane will cut HGV emissions by 38% over 10 years.
- Waiting for electric/hydrogen trucks will limit the drop over this period to just 6%.

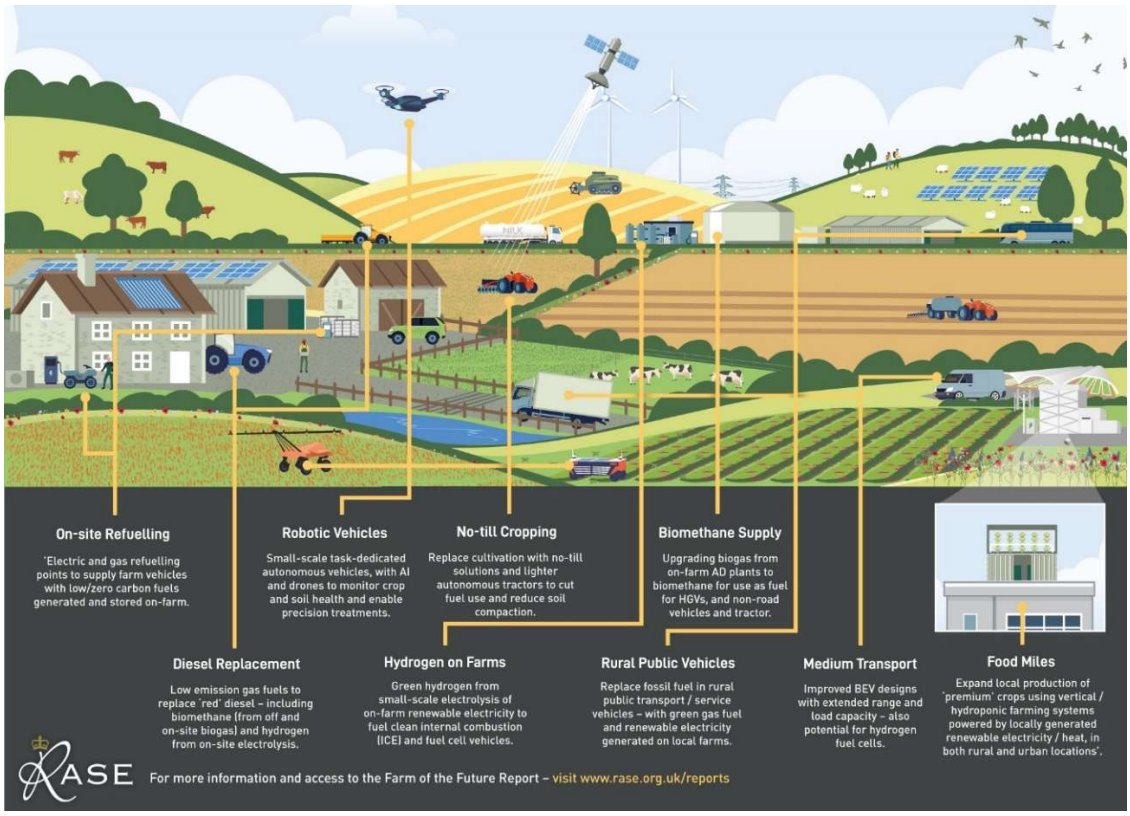
Biomethane (off and on grid) offers the best option to deliver early diesel replacement in rural areas. This can support the transition away from diesel to gas fuels for ICE engines used in production and haulage of a range of food products (from milk and potatoes to drinks and ready meals). BEIS and DfT should embrace the ability of off-grid biomethane to lead diesel replacement. The transition from diesel to gas fuels, will allow re-engineered clean ICE engines to be used in haulage and non-road vehicles, in rural and other applications, where BEV or Fuel Cell options may not be viable.

Also, as the GGSS does not apply to existing plants, sites are discouraged from investing in increased capacity (as they will not get a comparable return even though, for some AD sites, this would lead to more efficient plants. Biomethane supply as transport fuel offers a way of investing in existing biogas infrastructure in the next decade as the current FIT/RHI payments end or the CHPs reach end of life.

Boosting Rural Biomethane Output

It is understood that BEIS is reluctant to make long-term commitments to support the AD sector and that future restrictions on public spending may limit the scope for new incentive schemes. Even so, it is important, as indicated in the RASE report, that farms (plus agri-food businesses) are encouraged to proceed with decarbonisation of their activities. This includes access to bioenergy from residues.

It is unlikely that fertiliser and energy prices will fall in the short term. With some support, smaller scale biogas can help meet farmers' need to replace fossil fuel use for energy and nutrients. A more joined-up approach within Government on rural and agri-food decarbonisation would help to boost investment. Existing biogas plants could install on-site refuelling stations for biomethane vehicles immediately. Initial funding support for trial and demo sites will help deliver some impetus.



The RASE report highlights the need for investment in rural infrastructure and cleaner fuel supplies (see transport graphic above). It would help address the issues raised in the report if BEIS, DEFRA and DfT could work together to support deployment of adoption-ready solutions that can deliver affordable fuels to reduce emissions in rural areas, by facilitating more rapid fossil fuel replacement. Rural biogas production can contribute to decarbonisation of the rural economy (both existing and new plants). Modest Government funding will help stimulate rural low-carbon fuel production.