Biogas checklist

Who is this checklist for?

This checklist is primarily for European farmers and their advisors if there is an interest in generating biogas on their farm.

What is the best way to use this checklist?

This checklist focuses on anaerobic digestion and the production of biogas (and biomethane) on farms in an integrated food and energy production system. The focus is mainly on the use of green feedstock, such as crop residues, not livestock waste (such as manure and bedding material). It aims to get you thinking about all the aspects you need to consider if biogas is something you want to produce on your farm.

Work through the sections which are relevant for your farm and you could also look at the Renewable Energy checklist, bringing together general considerations for producing renewable energy on farm, and the Agrivoltaics Checklist which looks at combining solar panels and crops.

What it is not: This checklist is not a replacement for a professional feasibility study, it will not tell you if generating renewable energy on your farm is financially viable or possible, but it will help you to consider your options and think about whether it could work on your farm.

What is anaerobic digestion and biogas production?

Anaerobic digestion is the breakdown of organic matter in an oxygen free environment. In a controlled environment (e.g. an anaerobic digestor - AD) this process can use a range of organic wates (such as crop residues and livestock waste) to produce biogas and nutrient rich digestate. The biogas can be used, with a combined heat and power unit (CHP), to produce heat and electricity or further refined to produce biomethane which can be used as an alternative to natural gas. The digestate (which can be solid or liquid) can be used as fertiliser or soil improver.

In the checklist we look at:

- What – aspects need to be considered?

- Why – do they need be considered?
- Where – you can find information or advice

There are links to resources, organisations and projects where you could get support and more in-depth information, you could also have a look at the free online course *Integrating food and energy production on farmland* for more about integrated farming systems and renewable energy. Links may be information and websites from Value4Farm partners, national governments, European Union or European Commission, EU funded projects, research projects or commercial companies.

Please note:

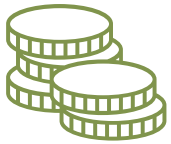
- Links are provided for information purposes and are not a recommendation for any companies or products linked to. Links to companies who are not Value4Farm partners are marked with "**".
- Links may be to information, services, tools etc. that may be free to access and use, require payment or require a subscription, wherever possible we have tried to make sure resources and information sources are open access / freely available.
- Information linked to may be general, or country or EU specific. For information specific to your own country or region you may need to do more searching.

You will find crossovers between the checklist sections, for example, the type and amount of feedstock you have may affect the size of the biogas plant and the energy outputs.

The checklist is divided into five main sections of factors to consider:

- Economic – Costs; Grants; Incomes; Partnerships; Risks
- Environmental – Crops; Location; Siting; Risks
- Governance – Regulations; Certification
- Social – Environment; Planning
- Technical – Digestate; Energy; Feedstock, Installation; Plant type; Risks

Economic:

What	Why	Where
Costs	**Costs of evaluating, installing and maintaining the technology**	
	Depending on how planning and construction is financed and if you are working in a partnership, you might need to consider the cost of: • Feasibility studies and input from advisors • Installation and building • Maintenance and upgrading or updating technology • Time needed for labour to run, service and maintain the technology • Connecting to national networks if energy (biomethane or electricity) is used off-farm • Delay between starting the plant and it running at "full" capacity • Labour requirements and knowledge needed to run the plant	Partial budgeting tool and summary of possible costs on the *Value4Farm DST webpage* *How costs to connect biomethane to gas grids are paid for - Common Futures study for EBA* ***Costs for a biogas plant: Energy output and revenues calculator*
Grants	**Grants, subsidies and other types of funding could be available from a range of sources to support installing and running anaerobic digestion and biogas production systems**	
	Grants may be available for (for example): Feasibility studies, construction, producing renewable energy. Funding could be available from local, regional, and national governments, and organisations such as the EU or FAO depending on your proposal or location. Grants could be dependent on your proposal (e.g. size of plant), farm location (e.g. close to protected areas) and region or country. Using crop residues for biogas production (as opposed growing dedicated energy crops) could mean agricultural support payments could still be	*Innovation Fund - Climate Action - European Commission* EU funding possibilities in the energy sector European Environment Agency - Sustainable finance Contact local organisations or advisors to identify funding opportunities available in your region, e.g. in Poland - Contact Point

	claimed. Land use rules and regulations for your location would need to be explored. As the process of producing biogas and biomethane can reduce methane emissions and using digestate as fertiliser and support soil carbon capture, you may want to explore grants or subsidies for carbon capture or GHG reductions.	for EU Financial Instruments and European Funds for Lublin 2021-2027
Incomes	**Incomes, and changes to farm incomes and costs also need to be considered**	
	Biogas production could lead to changes in some farm incomes, for example: • Income from energy exporting / selling energy • Income from leasing land if you form a partnership with a renewable energy company • Reduction in on-farm energy costs • Reduction in costs for fertiliser buy-in from digestate use There could also be changes in crop yields and crops grown – e.g. changing crop rotations to support feedstock production, use of residues as feedstock if they were previously sold	*ALFA Decision Support Tool – biogas* Partial budgeting tool on the *Value4Farm Decision Support Tool webpage* Summary of possible incomes on the *Value4Farm Decision Support Tool webpage*
Partnerships	**With renewable energy companies, with neighbouring farms, partnerships could support biogas production and your farm**	
	Partnerships could take a range of forms: • Leasing land to a company who install, manage and maintain the anaerobic digestor and biogas / biomethane production systems • With a renewable energy company to build and maintain technology • Partnerships and co-operatives with other local farms to share technology and pool / supply feedstock These partnerships could use feedstock from your and neighbouring farms, combine types of feedstock (e.g. crop residues, livestock slurry, manure and domestic food waste) and distribute or sell the digestate produced as fertiliser	Biogas and biomethane production case studies on the *Value4Farm Decision Support Tool webpage* *How to develop a community-led agricultural anaerobic digester* *AKIS (Agricultural Knowledge Innovation Systems) EU CAP Network*

	A partnership that works well for your farm and farm business could depend on: • Type and size of installation • The time and money you can invest • If getting feedstock from neighbouring farms, you need to consider how far will it have to travel and access to the biogas plant without too much impact on neighbours and local infrastructure	*Community energy toolkit (Welsh Government)* *Co-owned biorefinery model - Climate KIC* *Anaerobic digestion on a farm co-operative* ***MicroBiogasItalia*
Risks	**Introducing anaerobic digestion and biogas production could have financial risks**	
	Financial risks could include: • Fluctuating energy prices impacting on prices paid for renewable energy – both electricity and biomethane • Changing policies relating to green energy tariffs or payments • Risks to any partner companies / groups / organisations who are building or maintaining the technology or supplying feedstock • Upfront costs of construction	*Power Purchase Agreements (PPAs) - www.acer.europa.eu* *Risk Analysis Checklist for Biogas Projects*

Environmental:

What	Why	Where
Crops	**What do you currently grow, what rotations do you practice and what might change?**	
	What crops you grow and what residues might be available for biogas production, e.g. roots, husks, diseased crops, cover crops (see also – feedstock) What is your current rotation? • Duration • Food crops • Cover / catch crops • Nitrogen fixing opportunities Different crop rotations could benefit soil and support nitrogen retention in soil and rotations including cover crops or catch crops could provide biomass for biogas production. How might you enrich rotations? For example moving from a cereal mix to include legumes (or clover) to provide feedstock, enrich the soil and ensure nitrogen levels in soil are not too high to reduce chances of leaching.	NPK balancing - *Decision Support Tool - SustainFARM* Crop rotation and intercropping: • *Rotations for Field Vegetables - Technical Guide (Agricology)* and *Crop rotation and weed suppression* • *DiverIMPACTS - Rotation, Intercropping, Multiple Cropping* and *Extending crop rotations* • *Legume Hub* • Decision support system for intercropping (Leguminose) Crop adaptation: • *Soil navigator - assessing and optimising soil functions* • *ADAPT2CLIMA tool – supporting adaptation planning in agriculture*
	Are there ways you can encourage pollinators, soil fauna and pest control species with biodiversity strips, changing rotations, introducing soil cover, using agroecological techniques?	• Perennial flower strips – a tool for improving pest control in fruit orchards • Cool Farm Tool - Measure Carbon Footprint, Water & Biodiversity • Six Simple Steps to Regenerative Agriculture - Agricology • *DIVERFARMING - Crop diversification and low-input farming cross Europe* • *Organic Farm Knowledge*

Location	**Farm geographical location could impact on the production of biogas**	
	You may need to consider factors such as: • Average and seasonal variations in temperatures, digesters operate within specific temperature limits, too low and efficiency is reduced, too high and the bacteria in the digester can die. Ambient temperatures will affect how much a digester may need to be insulated or heated / cooled. • Precipitation - amount, patterns and type (e.g. rain or snow) – impacting on crops and crop residues available to use as feedstock • Potential for more extreme weather events, such as flooding and storms which could damage equipment and crops • How soils and climate can impact on feedstock availability, both the amount and type of crop residues available Distances: • For feedstock to be transported • To infrastructure, such as gas or electricity networks • To roads and access points Regulations affecting biogas production could also be location dependent, including grants and subsidies, planning rules, land use rules, and the impact of nearby conservation or preservation areas.	For policy, grants and regulations, see the Governance and Economic sections of this checklist. Biogas case studies on the *Value4Farm DST webpage* *Biogas Case studies across Europe – ALFA* Climate and weather: • *ADAPT2CLIMA tool – for supporting adaptation planning in agriculture* • *World Weather Information Service* • *The Weather Year Round Anywhere on Earth - Weather Spark*
Risks	**Producing biogas or biomethane could have environmental risks**	
	Although the energy produced is renewable and can be beneficial to the environment, the placement of the technology or how it is applied can have an impact. An Environmental Impact Assessment could be needed. If you are producing biogas you might need to consider: • Impact of building / construction work • Impact of storge of feedstock and digestate on the environment and the potential for pollution to e.g. water sources	*Risk Analysis Checklist for Biogas Projects* *Environmental Impact Assessment (EIA) for Anaerobic Digestion Projects (UK)*

Siting	**Where will the anaerobic digestor, CHP and biomethane plant be located on your farm?**	
	You will need to consider • Distance to national gas network if producing biomethane, or where a gas bottling plant could be sited • Distance to national electricity network if producing and exporting electricity • Distance the feedstock has to be transported to the digester • Where the feedstock will be stored • If the digestor or feedstock storage will be close to watercourses (possible pollution issues) • The impact on landscape and views • Distance to access points and roads for construction traffic and subsequent traffic movements associated with running the plant	*European Environment Agency Natura 2000 Viewer* EUNIS (European Nature Information System) *MAGIC (Multi-Agency Geographic Information for the Countryside) - geographic information about the UK natural environment* *European Commission Geodata* *CropSAT - Map your crop from satellite*

Governance:

What	Why	Where
Certification	**If you are producing renewable energy you might want to consider green energy certification**	
	If you intend to sell the renewable energy you are producing on your farm, certifying that it is from a renewable source could mean a guaranteed or higher price for it These could have a variety of names, such as Green Energy Certificates; Renewable Energy Certificates (RECS); Guarantees of Origin (GoOs); Renewable Energy Guarantees of Origin (REGOs) Anaerobic digestion and biogas and biomethane production could reduce your carbon and Greenhouse gas (GHG) emissions	*Using anaerobic digestion to reduce emissions - AHDB* Schemes and certification: • *European Commission Voluntary Schemes* • *Renewable Energy Guarantees of Origin (REGO)* • EU Emissions Trading System (EU ETS)
Regulations	**What regulations do you need to adhere to when constructing and running and anaerobic digestor (AD) and producing biogas?**	
	Regulations could depend on factors from the size of the AD plant and feedstock being used to the country or region your farm is located. They could focus on: • Plant location – for example away from rivers where there could be a pollution risk • Storage of feedstock prior to processing and storage of biogas or biomethane after production • Environmental risk assessments • Use of digestate as fertiliser, rules relating to application amounts and timing • Environmental permits – may be required if slurry, manure or food waste is being processed • The refining of biogas to biomethane	Examples of policy and regulations: • *RED III Feedstock Requirements for Biogas Plants - Teagasc (Ireland)* • *Biomethane - European Commission* • Digestate - *Anaerobic digestate: resource framework (UK)* The following organisations and trade publications could offer support and information: • *World Biogas Association*

	• The use, and amount of different feedstock used for biogas production, e.g. food waste, livestock manure or slurry	• *European Biogas Association*, with links to *National Biogas Associations* • *EUBIA - European Biomass Industry Association* • Belgium - *Inagro* – including *Information on small scale digesters* (in Dutch) • Italy - *CIB - Consorzio Italiano Biogas* • Poland - Biomass Magazine Consultancy and advisory services and farm clusters: • *Farm advisory services* • *AKIS - EU CAP Network* • *AEICA - Association of Independent Agricultural Consultants* • *Biogas forum – ALFA – Engagement Platform Forum* Environment and conservation: • *Managing and protecting Natura 2000 sites* • *EUNIS - European Nature Information System*

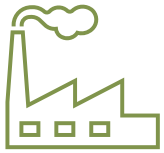
Social:

What	Why	Where
Environment	**What impact could a biogas plant have on the local environment?**	
	Have you considered the possible: • Impact on the landscape, e.g. historical features and views • Impact on nature and biodiversity • Impact on local roads and other infrastructure • Impact of the construction process Have a look at the "Regulatory" section of the checklist	*CALU (Centre for Alternative Land Use) On-farm energy generation and energy efficiency* Environment and conservation: • *Managing and protecting Natura 2000 sites* • *EUNIS - European Nature Information System*
Planning	**What will be the impact on local citizens and neighbouring farms and how might the views of locals impact on the planning process for a biogas plant?**	
	How will the plant impact on the local landscape and how might this affect local planning or land use regulations? Have you: • Spoken with the local community and residents about the benefits of biogas production from agricultural residues on both a local and national scale? • Explained the benefits of the technology and the process of making biogas (education can support positive public opinion) • Explained the sustainability and environmental benefits of using agricultural residues to produce energy? • Discussed the specific issues local citizens and neighbours may have with an anaerobic digester, for example odour? • Considered the impact on local roads and other infrastructure of the building / construction process	*World Biogas Association (WBA) factsheets* Information for the community: • *Biogas plants: what impact on my local community? (EBA)* • *5 things you should know about biogas and biomethane* • *Biomethane – a source of sustainable energy* • *Anaerobic Digestion energy factsheet* Setting up meetings: • *Organising a public meeting (Resource Centre)* • *Organising Successful Meetings (Seeds for Change)*

Technical:

What	Why	Where
Digestate	**What type of digestate could be produced and where could it be used?**	
	Digestate is the nutrient rich bi-product left after anaerobic digestion and can be used as a fertiliser, supporting a circular farming system. You need to consider: • Is the digestate wet or dry? Liquid or solid? This has implications for storage and application. • Nitrogen (and other nutrients) content – where can it be applied on your farm? • Are there any regulations related to use and storage of digestate on your farm? • What feedstock was used for anaerobic digestion (crop residues, livestock manure, food waste) this could affect how and where the resulting digestate can be used as fertiliser	• *Digestate as driver of the agroecological transition in Europe - European Biogas Association* • *EBA -Recommendations, Soil Health Law* • *Using digestate as a renewable biofertiliser* • *Using quality digestate to benefit crops* • *Anaerobic digestate: resource framework (UK)* • *www.soilnavigator.eu*
Energy	**What energy "type" do you want to produce, and will it be used on-farm or exported?**	
	Audit the energy use on your farm, what is used, where is it used and when is it used. This could support your decisions about (for example) what size of digester and plant to build, whether to produce biogas or refine further to biomethane and if you are using energy generated on farm or exporting it. Also consider the split between summer and winter in terms of energy production and energy needs, can any excess energy be stored?	Audits: • *The Farm Carbon Calculator* • *SustainFARM sustainability assessment for farms* • *Why and how to do an energy audit (Farm Advisory Service Scotland)* • *Farm Energy Audits* • *Energy Auditing In Agriculture (Teagasc, Ireland)* • *Centre for Alternative Land Use - Farmers guide to energy audits*

	Will you be producing: • Biogas • Heat • Electricity • Biomethane Will these be used on the farm or exported? If you are producing biomethane and exporting it, are you able to connect to the national gas network? Likewise for electricity if you are considering a CHP. Will the energy be stored in any way, for example gas storage or battery?	*How Costs to Connect Biomethane to Gas Grids are Paid For - European Biogas Association* *CALU (Centre for Alternative Land Use) On-farm energy generation and energy efficiency* *Energy translator - European Biogas Association*
Feedstock	**You need to consider what the feedstock for biogas production will be, how much energy it will generate, where it is coming from, and how much your farm will produce**	
	Will the feedstock be: • Crop residues • Livestock waste (e.g. bedding) • Manure • Food waste • Dedicated energy crops • A combination of 2 or more of the above How much, and what, preparation will the feedstock need? • Will it need maceration? • How much feedstock will your farm produce? • Will you take in feedstock from other farms? • Will you need to store feedstock before use? All these factors will impact on the way the digester is operated and the biogas and digestate produced. Feedstock used can impact on how digestate can be used. There may be restrictions on how much nitrogen from animal manure is allowed per hectare, if there is a small percentage in the feedstock the resulting digestate may be classified as animal manure, meaning not all the digestate can be used on	Feedstock: • From livestock - *ALFA Project* and *ALFA Decision Support Tool* • *WikiBiomass – European Biomass Industry Association* • *Inagro on youtube* • *Feedstocks - Information Portal on Anaerobic Digestion* • *Assessing the sustainable potential and cost of feedstocks for biogas and biomethane - IEA* Detailed look at feedstock preparation: • *Pretreatment of feedstock for enhanced biogas production - Bioenergy* • *Phyllis2 - Database of feedstock composition*

	farm. This could lead to surplus digestate being exported, resulting in extra costs.	
Plant type	**What type and size of anaerobic digester and CHP (Combined Heat and Power unit) or will you be further refining to biomethane?**	
	What size of plant are you considering: • Digester capacity • Feedstock required (type and amount) • Outputs The size and capacity of the digester and CHP will impact on the quantity of feedstock required and the energy generated What type of plant? • Anaerobic digester and CHP to generate electricity and heat • Further refine the biogas to produce biomethane – an alternative to natural gas? Consider the balance between cost of plant and installation and income generated, size of installation (i.e. Production capacity)	Biogas case studies on the *Value4Farm Decision Support Tool webpage* Case studies showcasing different types and sizes of plant: • *ADBA (Anaerobic Digestion & Bioresources Association)* • *Biogas Cases – ALFA Engagement Platform* • *Anaerobic digestion on a UK farm* • *Inagro - pocket digester case studies* (in Dutch) Example plants on YouTube: • *Large arable crop fed digester in the UK Apsley Farms* • ***Micro digester - Economad* • *Research Biogas Plant at Aarhus University* • *Inagro - using agricultural residues as feedstock for biogas* • *Inagro - small scale anaerobic digestion* • *Inagro - Value4Farm demo site in Belgium*

Installation	**During the plant installation, what might need particular consideration and planning for?**	
	Is there suitable access to the site for installation equipment? What will be the impact of building on the local community?	Installation - *RES EU certification* Example Biogas plant installations: • *Time lapse: Building a biogas plant in 60 days* • *Large scale biogas plant in Ireland*
Risk	**Anaerobic digestion and biogas production could have a number of risk factors**	
	There could be risks to workers during construction, maintenance and running of the anaerobic digester and associated CHP or biomethanation plant.	• *Renewable Energy Systems Installers EU certification* • *Risks and safety measures for anaerobic digestion: How can you make your plant safer? :BiogasWorld* • *Risk management programme for biogas production by anaerobic digestion* • Example risk assessment - *SR2021 No 7: generic risk assessment anaerobic digestion facility (UK)*

Next steps

Now you have had a look through the checklist of considerations for producing biogas (and possibly biomethane) on your farm, what next?

This checklist is part of a Decision Support Tool (DST) developed by the Value4Farm project, to support farmers interested in generating renewable energy on their farm and integrating the production of crops and energy.

The DST contains:

- An Open Access Online Course – Integrating Food and Energy Production on Farmland – which looks at the benefits and challenges of renewable energy generation on farmland
- An Audit Tool to evaluate the farm to support farmers and their advisors in deciding which path to follow in order to produce renewable energy via biogas or agrivoltaics
- A Transition Tool (of which this checklist is a part) to help you take the next steps if agrivoltaics or biogas (or both) could be useful on your farm. The Transition Tool also has checklists for agrivoltaics and renewable energy generation, case studies of agrivoltaics and biogas and an introductory budget tool to help you consider the economic impacts of these technologies on your farm

If you haven't already explored these resources you may find them useful in thinking about your next steps. All are free to use and are available on the Value4Farm website - https://value4farm.eu/

You might consider speaking to an Agricultural Advisor who specialises in renewable energy and renewable energy technologies, or looking into having a feasibility study done. The following links could be useful:

- *EU Farm advisory services*
- AKIS (Agricultural Knowledge Innovation Systems) EU CAP Network
- *AEICA - Association of Independent Agricultural Consultants (EU)*

Biogas associations may also be a useful source of information, for example:

- *CIB - Consorzio Italiano Biogas*
- *World Biogas Association*
- *European Biogas Association*
- *European Biomass Industry Association*

Your first starting point could be as simple as an action plan, an action plan outline is available on the *Value4Farm Decision Support Tool webpage*

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