

Renewable energy checklist

Who is the checklist for?

This checklist is primarily for European farmers and their advisors who have an interest in generating renewable energy on their farms.

About the checklist

This checklist brings together a range of aspects about the generation of renewable energy on farmland in an integrated food and energy production system. It covers general points to consider if you are thinking about generating renewable energy on farm. Checklists which specifically focus on agrivoltaics and the production of biogas are also available. These form part of a Transition Tool which will help you consider all the factors around generating renewable energy, mainly through the use of agrivoltaics and the production of biogas. We focus on these two technologies as they offer opportunities to *integrate food and energy production* in arable farming systems.

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.

In the checklist we look at:

- What – aspects need to be considered?
- Why – do they need be considered?
- Where – you can find information and advice

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

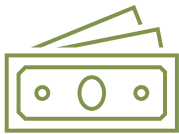
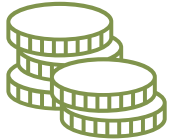
Please note:

- 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.

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

- **Economic** – Costs; Grants; Incomes; Partnerships; Risks
- **Environmental** – Crops; Location; Risks; Siting
- **Governance** – Certification; Regulatory
- **Social** - Societal
- **Technical** – Energy; Installation

Economic:

What	Why	Where
Costs	Costs of evaluating, installing and maintaining the technology	
	You might need to factor in: • Feasibility studies and input from advisors • Installation / building costs • Maintenance costs • Upgrading / updating costs • Time costs – time needed for labour to run, service and maintain the technology • Delay between building / introducing the technology and it running at “full” capacity	Partial budgeting tool on the <i>Value4Farm Decision Support Tool</i> webpage Summary of possible costs on the <i>Value4Farm Decision Support Tool</i> webpage <i>CREST: Cost of Renewable Energy Spreadsheet Tool (USA)</i>
Grants	Grants and subsidies for renewable energy production technologies could be available from a range of sources	
	Grants may be available for: • Feasibility studies • Education and training • Construction • Producing renewable energy • Energy efficiency measures Grants could be available from local, regional or national governments, and organisations such as the EU or FAO or UN depending on your proposal or location.	<i>EU funding possibilities in the energy sector</i> <i>European Environment Agency - Sustainable Finance</i> <i>Poland - Contact Point for EU Financial Instruments</i> <i>Poland - European Funds for Lublin</i>

Incomes	Incomes, and changes to farm incomes and costs also need to be considered	
	In moving towards an integrated system of food and energy production you could find increases and decreases in some incomes, for example: • Gaining income from energy exporting / selling energy • Gaining income from “renting” land if you form a partnership with a renewable energy company • Reduction in on-farm energy costs	<i>Building climate-resilient agriculture in Europe: an economic perspective - European Environment Agency (EEA)</i> Partial budgeting tool on the <i>Value4Farm Decision Support Tool</i> webpage Summary of possible costs on the <i>Value4Farm Decision Support Tool</i> webpage
Partnerships	With renewable energy companies, with neighbouring farms, partnerships could support renewable energy generation and your farm	
	You could consider: • Working with renewable energy company to support building and maintaining • Working with neighbouring farms to share resources - land, crops, equipment Community group renewable energy projects could provide a useful model of partnerships.	Networks and clusters: • <i>Agricultural Knowledge and Innovation Systems (AKIS) EU CAP Network</i> • <i>Biorefine cluster Europe</i> • <i>Community energy toolkit</i> Example partnership and co-operatives: • <i>Anaerobic digestion on a farm - partnership in the UK</i> • <i>Eno Energy Cooperative - Finland</i> • <i>Energy4All - Renewable Energy Co-operatives in the UK</i>

Risks	Renewable energy generation systems could have financial risks	
	Financial risks could include: • Fluctuating energy prices impacting on prices paid for renewable energy • Changing policies relating to green energy tariff or payments • Risks to any partner companies / groups / organisations • Upfront costs of construction	<i>** Risk management in renewable energy projects</i> <i>Power Purchase Agreements (PPAs)</i>

Environmental:

What	Why	Where
Crops	Will the technology impact on your crops?	
	If you are integrating food and energy production on your farmland, what will you be combining the technology with? • Arable crops • Arable crops and livestock • Vegetables • Fruit / vines • Livestock This could support your decision on what type of energy generation would best suit your farm Also consider if the technologies will: • Reduce land available for crop growing – how might this be mitigated? • Impact on machinery / equipment used for e.g. planting or harvesting • Change shading patterns or soil moisture, which could impact positively or negatively on yields • Lead to a change in rotations	On-farm renewable energy technologies • <i>Energy Generation - Farm Carbon Toolkit</i> • <i>6 ways to integrate renewable energy into agriculture - Climate KIC</i> Explore some of the impacts of agrivoltaics: • <i>Value4Farm demo site in Denmark</i> • <i>Value4Farm demo site in Italy</i> <i>Inagro pilots - using agricultural residues as feedstock for biogas fermentation</i>

Location	The geographical location of your farm will impact on a range of considerations, from climatic to policy	
	Policy impacts, such as grants and subsidies, planning rules, land use rules, designated conservation or preservation areas, will vary according to location. Climatic aspects such as: • Average and seasonal variations in temperatures • Solar radiation levels and annual patterns • Precipitation - amount, patterns and type (e.g. rain or snow) • Future likelihood of more extreme weather events – flooding, storms Will impact on most effective type of renewable energy generation	For policy, grants and regulations etc, see the governance and economic sections of this checklist. Weather and climate: • <i>World Weather Information Service</i> • <i>The Weather Year Round Anywhere on Earth - Weather Spark</i> • <i>Extreme weather: floods, droughts and heatwaves - European Environment Agency (EEA)</i> • <i>Example of regional weather alerts - Allerta Emilia Romagna</i> Climate change: • <i>CRISP: Climate Risk Planning & Managing Tool for Development Programmes in Agri-food Systems</i> • <i>AWA- AgriAdapt platform for adapting farms to climate change</i>

Risks	Renewable energy generation systems 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 impact on the farm or local environment. It could bring risks to the environment and require an Environmental Impact Assessment. There could also be risks to the technology from environmental or climate change	<i>Environmental Impact Assessments for Solar and Wind</i> <i>Risk assessments for your environmental permit - UK example</i> <i>Think Hazard - general view of hazards to consider to promote disaster and climate resilience</i> <i>AWA- AgriAdapt platform for adapting farms to climate change</i>
Siting	Where will your energy generation technology be sited on your farm?	
	What technology are you considering for renewable energy generation? Depending on the technology, you will need to look at or consider: • Where the energy generated might be used on the farm and any internal connections needed • Scale of installation and the proportion of farmland to be used • Distance to national energy networks (e.g. electricity or gas) if you are exporting energy • Distance to access points and roads for construction traffic • Topography and soils on your farm – can they physically support the technology and grow crops • The impact on the landscape, e.g. environmental and visual impacts	Audit Tool on the <i>Value4Farm Decision Support Tool</i> webpage <i>Land App digital mapping software for farmers (UK)</i> <i>Practical guide to small scale renewables - Farm Advisory Service Scotland</i>

Governance:

What	Why	Where
Certification	If you are producing renewable energy on your farm you might want to consider green energy certification	
	If you intend to sell the 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 certificates 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) You might also consider: • Emissions Trading Schemes • Carbon Capture or Storage Schemes	<i>European Commission Voluntary schemes</i> <i>Renewable Energy Guarantees of Origin (REGO)</i> <i>EU Emissions Trading System (EU ETS)</i> <i>Carbon Removals and Carbon Farming - European Commission</i> <i>Certification for carbon removals and carbon farming (CRCF)</i>
Regulatory	What regulations relating to renewable energy technologies do you need to adhere to?	
	The regulations you need to adhere to will depend on a range of factors, from type of technology being used to the country or region your farm is located. Depending on what technologies you are planning to use (for example are you considering wind turbines, solar panels, growing biomass, anaerobic digestion, installing a ground heat pump) there may be regulations related to: • Technology placement	Examples of policy and regulations: • <i>Renewable Energy Directive</i> • <i>Renewable energy targets - European Commission</i> • <i>Common agricultural policy and bioenergy</i> • <i>Use of agricultural land for renewable energy generation - Ireland</i>

	• Environmental risk assessments • Environmental permits • Land use changes • Planning permission Seek advice or information from: • Government agricultural or farming department • Regional environmental and planning officers / advisors • Agricultural advisors • Local farmers or farm cluster groups	• <i>Enabling framework for renewables</i> Advisory and consultancy: • <i>European Commission Farm advisory services</i> • <i>Agricultural Knowledge and Innovation Systems (AKIS) EU CAP Network</i> • <i>Supporting farmers towards climate-resilient food futures - Climate KIC</i> Renewable energy projects in the UK: • <i>Renewable Energy Planning Database</i> • <i>Renewable Energy Planning Database</i> Conservation sites: • <i>Managing and protecting Natura 2000 sites</i> • <i>EUNIS - European Nature Information System</i>
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Social:

What	Why	Where
Societal	Have you sought the views of local citizens and neighbouring farmers?	
	Have you considered the possible: • Impact on the landscape – historical features, views, • Impact on nature/biodiversity • Impact on local roads and other infrastructure Have you explored and explained the benefits of the technology and the construction / building process? Education and raising awareness can support positive public opinion, and you can highlight: • Environmental benefits of the technology – local, national and global • Energy security – both for the farm and wider society • Financial benefits, such as reducing the impact of fluctuating energy prices	<i>REPowerEU</i> <i>Renewable energy and powering a safer future - United Nations</i>

Technical:

What	Why	Where
Energy	Where do you use energy on farm and what type(s) of energy do you intend to produce?	
	Audit the energy use on your farm – what is used, where is it used and when is it used. This could support your decision about what technology to develop and whether you are using the energy you generate on the farm or exporting it. An Energy Audit might look at what types of energy you use, e.g. electricity, diesel, gas or heat Where energy is used on your farm, and where the highest use is: • Farm buildings – heating, lighting, climate control • Equipment – Vehicles, machinery systems e.g. irrigation • Crop processing	Energy audits: • <i>The Farm Carbon Calculator</i> • <i>SustainFARM sustainability assessment for farms</i> • <i>Why and how to do an energy audit (Farm Advisory Service Scotland)</i> • <i>Farm Energy Audits</i> • <i>Energy Auditing In Agriculture (Teagasc, Ireland)</i> • <i>CALU Centre for Alternative Land Use - Farmers guide to energy audits</i>
	When is the highest use? If your highest use is at night, you could also consider BESS (battery energy storage systems) if you are thinking about solar power generation If there are opportunities to change energy usage, e.g.: • Using electric vehicles or equipment • Improving energy efficiency in vehicles, buildings or operations (e.g. irrigation systems)	<i>Already Have Solar Panels? Adding Battery Storage to Your Farm - NFU Energy</i> Efficiency: • <i>Farm carbon cutting toolkit - energy efficiency</i> • <i>Agricultural Sector Energy Efficiency Tips - EDF Advice Hub</i> • <i>Energy Audit Checklist (EDF energy)</i> • <i>Carbon Trust - Energy efficiency in agriculture</i>

	If you generate renewable energy, will you be: • Selling it for use off the farm • Using it on farm • Both Will you be producing (for example): • Electricity • Biomethane • Heat • Biomass Will the energy be stored in any way – for example a BESS (battery energy storage system)?	• <i>Energy Generation - Farm Carbon Toolkit</i> • <i>European Biogas Association (EBA) Energy system integration</i> • <i>Anaerobic digestion blog -biogas vs solar vs wind for farms (USA)</i> • <i>Solar Integration: Solar Energy and Storage Basics (Department of Energy)</i> • <i>**Farming the Future: BESS & Agrivoltaics (Eco Green Energy)</i>
Installation	During the installing of the renewable energy technology, what might need particular consideration and planning for?	
	Is there suitable access to the site for installation equipment? Is the land suitable? Can it take the weight of the installation equipment and the technology (e.g. solar panels or wind turbine)? Soil compaction during installation can be an issue, what steps might you need to take to mitigate this? What will be the impact of building on the local community? During construction and maintenance there could be risks to workers	Example agrivoltaic installations: • <i>RemTec agrivoltaics installation</i> • <i>HyperFarm agrivoltaics installation at German pilot site</i> Example Biogas plant installations: • <i>Time lapse: Building a biogas plant in 60 days</i> • <i>Large scale plant in Ireland - WELTEC BIOPOWER - Large scale Biomethane Plant Construction in Ireland</i> Example wind turbine installations: • <i>Wind turbine Installation time lapse</i> • <i>Building a Wind Turbine Installation - RES EU certification</i>

Next steps

Now you have had a look through the checklist of considerations for generating renewable energy 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 biogas and agrivoltaics, 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 - *[value4farm](https://value4farm.eu) – Sustainable renewable energy value chains for answering farmers' needs*

You might consider speaking to an Agricultural Advisor who specialises in renewable energy and renewable energy technologies or explore the possibility of having a professional feasibility study undertaken. The following links could be useful:

- *[European Commission Farm advisory services](#)*
- *[AKIS \(Agricultural Knowledge Exchange Systems\) EU CAP Network](#)*
- *[AEICA - Association of Independent Agricultural Consultants](#)*

Renewable energy groups and associations may also be able to offer information, for example:

- *EUREC – The Association of European Renewable Energy Research Centers*
- *French Renewable Energy Trade Association - Syndicat des énergies renouvelables*

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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