The role of energy efficient and renewable technologies in decarbonising agriculture

Signpost Series - Energy

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Reminder Key Agricultural Emissions

Greenhouse Gas (GHG)	Where from on the farm?		Total: 20.1 Mt of CO2 eq in agriculture of which
Carbon Dioxide CO_2	Burning of fossil fuels		0.94 Mt of CO_2 eq **5%**
Methane CH_4	Natural bi-product of enteric fermentation		12.97 Mt of CO_2 eq **64%**
Nitrous Oxide N_20	Naturally produced; emissions can be increased by cultivation & N fertiliser		6.3 Mt of CO_2 eq **31%**

CO_2 Emission Factor 2018

Energy Source	CO_2 emission kg/kWh
Grid electricity	0.375
Natural Gas combustion - Heating	0.205
Coal - combustion	0.340
Kerosene	0.257

If I use 4,000 kWh of electricity in the year I'm producing 4,000 x 0.375kg = 1,500kg or **1.5tonnes** of CO_2

Kerosene Oil has 10.5 kWh per litre. 1,000 litres = 10,500 kWh
10,500 x 0.257 = 2,698 kg or **2.7 tonnes** of CO_2

Possible on-farm energy generation

- Micro-hydro electricity schemes
- Solar panels, ground source heat pumps or wood fuel burners
- Wind turbines
- Growing trees, short rotation forestry, or energy crops such as short rotation coppice or miscanthus as biomass fuel for home supply or sale
- Installing an anaerobic digester to produce methane as fuel for electricity or heat

Why invest in renewable energy

- An opportunity to generate an income through Government incentives
- Makes use of on farm resources from slurry to forestry, straw, wind and rivers.
- Energy generated can be used to generate additional income
- Reduction in GHG emissions

Energy Awareness

- Develop tools to create awareness among staff
- SEAI offer a range of training and supports around energy management and standards.
- Classroom based energy management training for companies
- More effective use of thermostats, time clocks, motion sensors and insulation
- Vehicle checks and maintenance
- Assess on-farm storage facilities, for example, potato stores, to ensure that insulation and natural ventilation is utilised and energy is used efficiently

Lighting – Pig Units

- Lighting accounts for one of the greatest inefficiencies
- Fluorescent lighting and lower energy can reduce costs by up to 80%
- LED allow to match lighting levels and colour to animals needs
- Many units still use tungsten bulbs which are cheap but inefficient at 2 – 4 kWh ppp
- Fluorescent strip lighting can reduce this to 0.8 kWh ppp

3.2 kWh x 0.375 kg of CO_2 = 1.2 kg of CO_2 ppp

LED Lighting

Cost of LED Lighting and fitting €71 + €4	€75
Energy used by LED light	25 W
Energy used by double fluorescent tubes	116 W
Hours of light per day	14
Saving in electricity (116W – 25W)	91 W
At 14 hours per day (14 x 91W)	1274 Wh
For 365 days	465 kWh
At 18 cent per kWh / unit of electricity = 465 x 0.18	€84
Accelerated Capital Allowances (TAX)	

CO2 savings 465 x 0.375 kg of CO2 per kWh = **174 kg**

Selecting high efficient pumps aerators and separators

- Should be considered when specifying or upgrading motors for feed or manure handling
- Fitting a Variable Speed Pump can reduce costs by 30%
- Inefficient motors typically require 6kWh ppp
- Efficient motors 2 kWh ppp
- Saving 4 kWh ppp

4kWh x 0.375 kg of CO_2 = 1.5kg of CO_2 per pig produced

Insulation of pig units

- Good insulation reduces amount of heat lost and heat coming in.
- Heat lost through the walls of the building requires supplementary heat increasing costs.
- Fitting composite panels containing solid polyurethane insulation, protected from moisture ingress, is recommended.

  - Typical insulation 9kWh per pig produced

  - Best Practice = 3 kWh

  - Saving 6kWh per pig produced

6kWh x 0.375 kg of CO_2 = 2.25kg of CO_2 per pig produced

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Ventilation

- Ventilation is designed to optimise the living conditions of pigs
- Typical finishing building ventilation fans using 7.2 kWh per pig produced (ppp)
- Best practice could achieve 4 kWh ppp
- Saving – 3.2 kWh ppp

3.2 x 0.375 kg of CO_2 = 1.2kg of CO_2 per pig produced

Fit efficient fans

- A single fan in a finishing building will consume its own value in 12 months
- Paying 10% more on a more energy efficient fan will pay for itself in the same time
- Clean dust & debris from fan blades
- Typical finishing building 10 kWh ppp
- Best practice efficient fans 6 kWh ppp
- Saving 4 kWh ppp

4 x 0.375 kg of CO_2 = 1.5kg of CO_2 per pig produced

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Variable Speed Drives

- SEAI grant aid 40% for VSD – 2017, 2018, 2019 (€1m)
- VSD reduces electricity consumption by 56 – 65%
- Vaccum pumps account for 7.12 Wh per litre of milk produced

Year	No of grants paid	CO2 Emissions without VSD	CO2 Emissions with VSD	Annual Co2 Savings
2017	48	142	71	71
2018	69	184	92	92
2019	111	251	125	125
overall	228	577	288	288

Heat Pumps

- ASHP to warm under floor heating system
- LPG heated sheds require increased ventilation – higher CO_2 and humidity levels
- Underfloor heating system, air exchange unit and back up LPG heater.

Role of biomass production in GHG mitigation.

- Sequestering Carbon in the soil and biomass.
- Mitigation of nitrous oxide via reduced N requirement.
- Reduced emissions associated with fuel usage and manufacture of inputs.
- Substitution of fossil fuels for energy generation and heat production.

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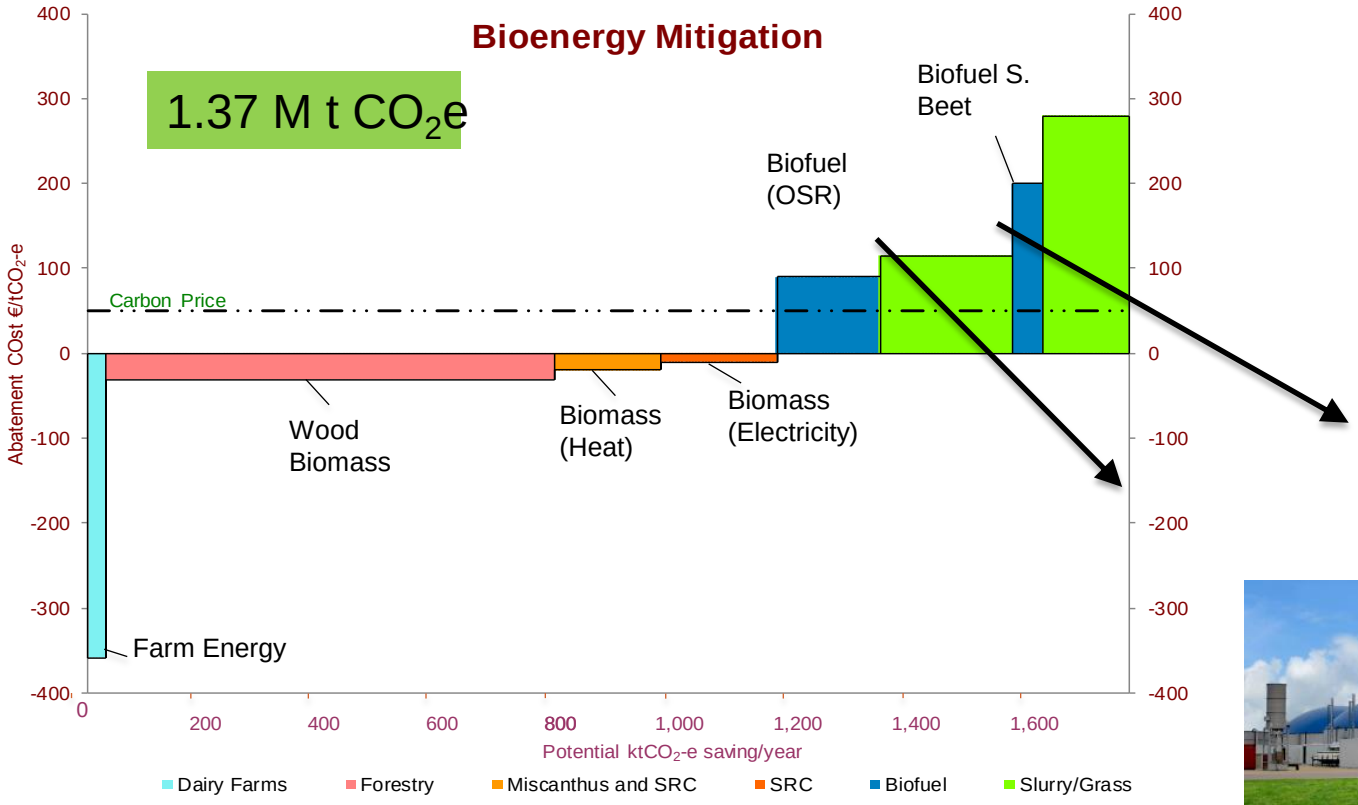
MACC – Energy Abatement



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Biomass heating - SSRH tariff levels (Cent for each kWh of heat produced)

Tier	Lower Limit (MWh/yr)	Upper Limit (MWh yr)	Biomass Heating Systems Tariff (c/kWh yr)	Amount/yr
1	0	300	5.66	€16,980
2	300	1,000	3.02	€20,650
3	1,000	2,400	0.5	€7,000
4	2,400	10,000	0.5	€38,000
5	10,000	50,000	0.37	€148,000
Total				€230,630

SSRH Example

- Poultry Unit
- 400 kW boiler – cost €360,000
- Run 1,700,000 kWh/year (50% load)
- Oil Displaced = 160,500 litres
- Oil Cost pa = €105,930 (0.66 c/litre)
- Wood Chip cost pa = €58,000
- Saving pa = **€47,930**
- Payback without grant or SSRH = 6.2 years

SSRH extra income = 300 MWh x €56.6 = €16,980 +

700 MWh x €30.20 = €21,140 + = **€41,620**

700 MWh x €5 = €3,500

Heat Saving from wood chip + SSRH = **€89,550** or payback 4 years

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GHG savings in poultry unit

- Emission factor oil = 0.257 kg CO_2 - per kWh

1.7m kWh x 0.257 = 437 tonnes of CO_2

Value of Straw Compared to Oil

Bale Type	Bale Weight	Kilo watt hours (kWh) per bale	Oil equivalent (litres)	Oil Value equivalent (€0.60 c/L)
4 x 4 Round	150kg	690	66	€40
5 x 4 Round	250kg	1,150	110	€66
8 x 4 x 4 Square	500kg	2,300	220	€132

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PV cuts your Carbon Footprint

- Each kWh of electricity generated by fossil fuels produces around 0.375 kg of carbon dioxide.
- A 20 kW PV system will produce about 20 x 800 kWh per year (16,000 kWh)
- This reduces the carbon footprint of the business by 16,000 x 0.375 kg = 6,000 kg of **6 tonnes of CO_2**

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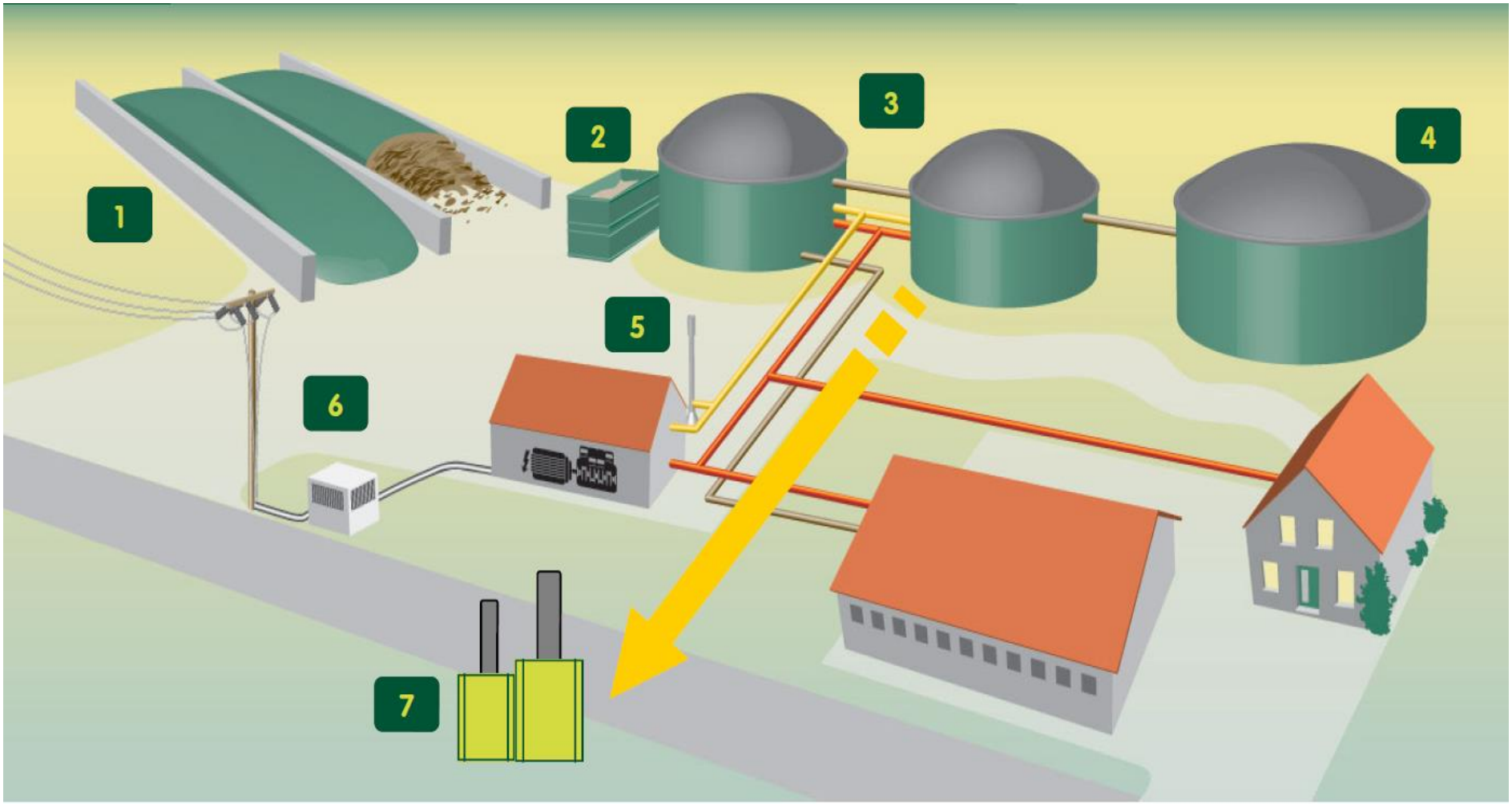
Biogas Plant



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Biogas – 15 year - SSRH tariff levels (Cent for each kWh of heat produced)

Tier	Lower Limit (MWh/yr)	Upper Limit (MWh yr)	Anaerobic Digestion (c/kWh yr)	Amount/yr
1	0	300	2.95	€8,850
2	300	1,000	2.95	€20,650
3	1,000	1,400	0.50	€2,000
Total				**€31,500**

Conclusions

- Energy efficiency should be the first fuel on all farms.
- There is a large variation in energy costs on Irish farms. Every farmer can calculate their own energy costs.
- Payback periods on renewables technologies can vary considerably. Paybacks should be calculated.
- Energy crops can mitigate emission production within agriculture and energy.