



The role of energy efficient and renewable technologies in decarbonising agriculture




# Signpost Series - Energy

Webinar – August 28<sup>th</sup> 2020

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# Reminder Key Agricultural Emissions

Greenhouse Gas (GHG)	Where from on the farm?		Total: 20.1 Mt of CO <sub>2</sub> eq in agriculture of which
Carbon Dioxide CO <sub>2</sub>	Burning of fossil fuels		0.94 Mt of CO <sub>2</sub> eq <b>5%</b>
Methane CH <sub>4</sub>	Natural bi-product of enteric fermentation		12.97 Mt of CO <sub>2</sub> eq <b>64%</b>
Nitrous Oxide N <sub>2</sub> O	Naturally produced; emissions can be increased by cultivation & N fertiliser		6.3 Mt of CO <sub>2</sub> eq <b>31%</b>

# CO<sub>2</sub> Emission Factor 2018

Energy Source	CO <sub>2</sub> 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  $4,000 \times 0.375\text{kg} = 1,500\text{kg}$  or **1.5 tonnes** of CO<sub>2</sub>

Kerosene Oil has 10.5 kWh per litre. 1,000 litres = 10,500 kWh  
 $10,500 \times 0.257 = 2,698\text{ kg}$  or **2.7 tonnes** of CO<sub>2</sub>

# 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<sub>2</sub> = 1.2 kg of CO<sub>2</sub> ppp

# LED Lighting

<b>Cost of LED Lighting and fitting €71 + €4</b>	<b>€75</b>
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<sub>2</sub> = 1.5kg of CO<sub>2</sub> 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<sub>2</sub> = 2.25kg of CO<sub>2</sub> per pig produced

# 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<sub>2</sub> = 1.2kg of CO<sub>2</sub> 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<sub>2</sub> = 1.5kg of CO<sub>2</sub> per pig produced

# Variable Speed Drives

- SEAI grant aid 40% for VSD – 2017, 2018, 2019 (€1m)
- VSD reduces electricity consumption by 56 – 65%
- Vacuum 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<sub>2</sub> and humidity levels
- Underfloor heating system, air exchange unit and back up LPG heater.

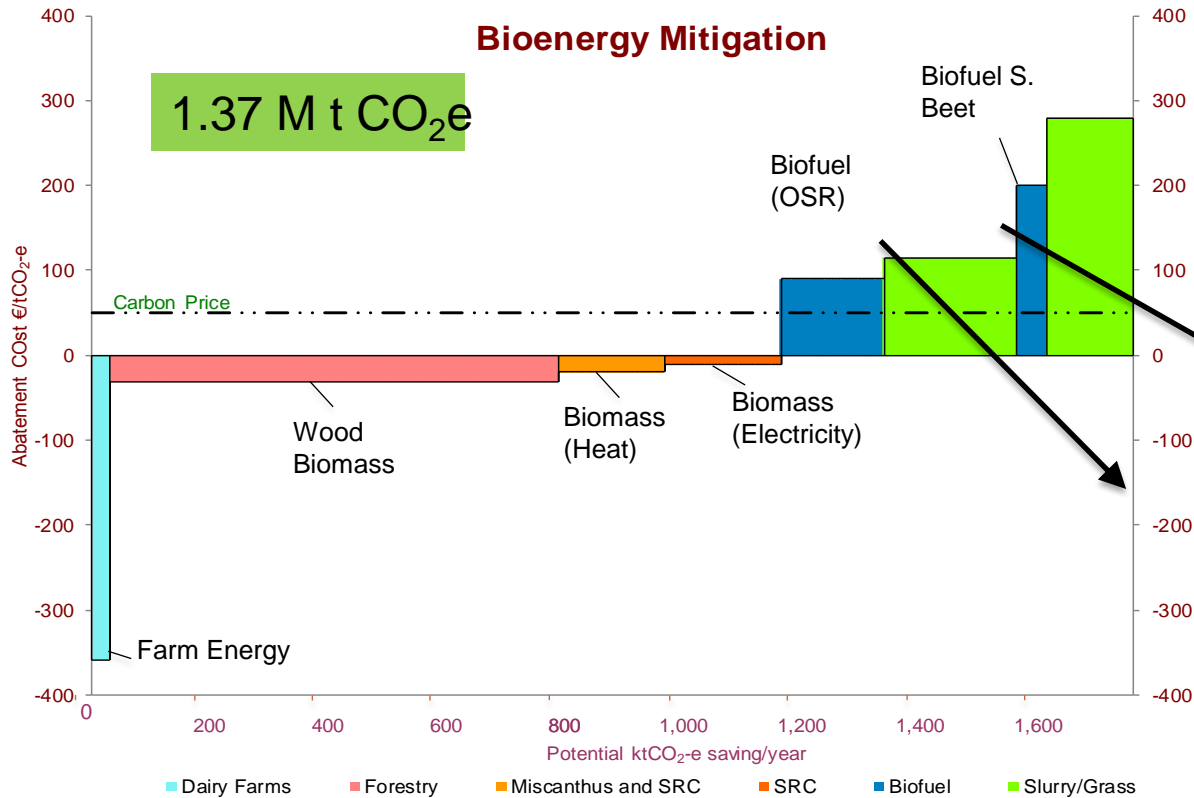


# Role of biomass production in GHG mitigation.

- 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.



# MACC – Energy Abatement





## 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
<b>Total</b>				<b>€230,630</b>

# 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

# GHG savings in poultry unit

- Emission factor oil = 0.257 kg CO<sub>2</sub> - per kWh

1.7m kWh x 0.257 = 437 tonnes of CO<sub>2</sub>

# Value of Straw Compared to Oil

<b>Bale Type</b>	<b>Bale Weight</b>	<b>Kilo watt hours (kWh) per bale</b>	<b>Oil equivalent (litres)</b>	<b>Oil Value equivalent (€0.60 c/L)</b>
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

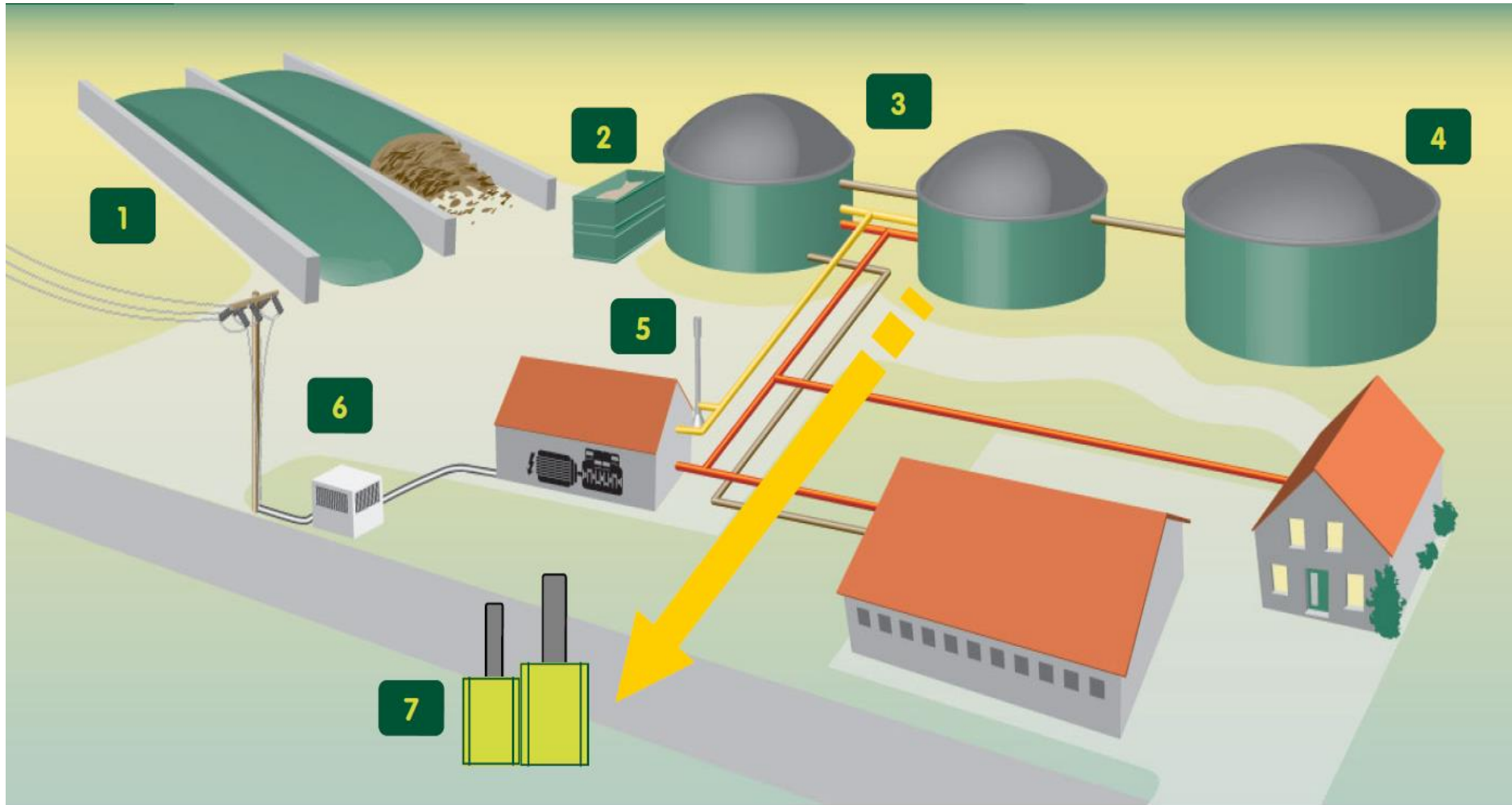


# PV cuts your Carbon Footprint

- 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  $16,000 \times 0.375 \text{ kg} = 6,000 \text{ kg}$  of **6 tonnes of CO<sub>2</sub>**



# Biogas Plant



## 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
<b>Total</b>				<b>€31,500</b>

# 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.