



Greenhouse Gas Training Day

Navan – December 2nd 2019

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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

Renewable technologies suited to most farms

- Wind energy
- Hydropower
- Anaerobic digestion / biogas
- Solar photovoltaic (PV)
- Heat pumps

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

GHG Balance Energy Crops

- LULUCF already offsets almost 1.5m tonnes of emissions per annum.
- The conversion of pasture to SRC or SRF has potential to help meet GHG targets.

Realising this mitigation requires:

- (a) The conversion of a substantial portion of land to biomass
- (b) Selection of suitable crop types
- (c) Development of reliable combustion systems
- (d) Rigorous measurement of emissions and carbon sequestration during cultivation

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.



Carbon sequestration

- C input into the soil – association with the conversion of tillage land to biomass – between 2.8 – 4.1t CO₂ ha yr for miscanthus and 1.8 – 2.7t CO₂ ha year for willow
- If below ground biomass was included it would add another 0.5 – 1 t CO₂ ha
- May take 2 – 3 years to reach this seq level

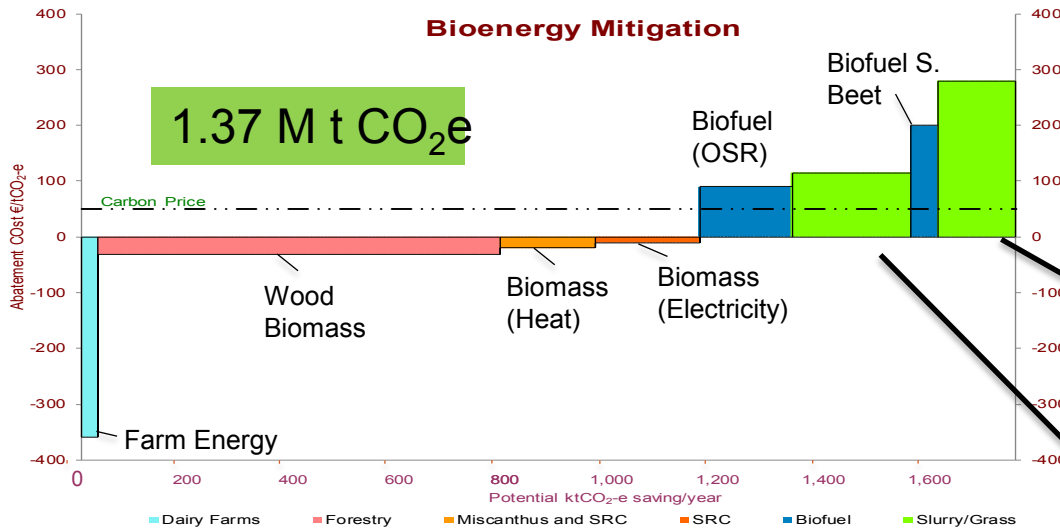
Mitigation of nitrous oxide

- Potential for large N₂O release particularly after ploughing grassland (2 - 4 tonnes ha N₂O emissions recorded).
- Miscanthus and willow are considered nutrient efficient. Require less N fertiliser than grassland.

Displacement of fossil fuels

- When biomass feedstocks are combusted C is released
- Ancient versus modern Carbon
- Total emissions per unit energy produced from coal, oil, gas or peat are 3 to 7 times higher than that from biomass.

MACC – Energy Abatement



MACC – Energy measures

- Use of biomass (woodchip and perennials)
- Energy saving on farm
- The use of grass based AD and biomethane
- Biofuels and agricultural by-products for fossil fuel replacement
- Bioenergy crops along with AD adoption, biomethane and on-farm energy saving has potential for reduction of 1.37 MT of CO₂ per annum
- Assumptions: primarily forestry, 25,000ha biomass crops, grass based AD

CO₂ Emission Factor

Energy Source	CO ₂ emission kg/kWh
Grid electricity	0.437
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 $4,000 \times 0.437\text{kg} = 1,748\text{kg}$ or 1.75tonnes of CO₂

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 CO₂

Energy use on dairy farms

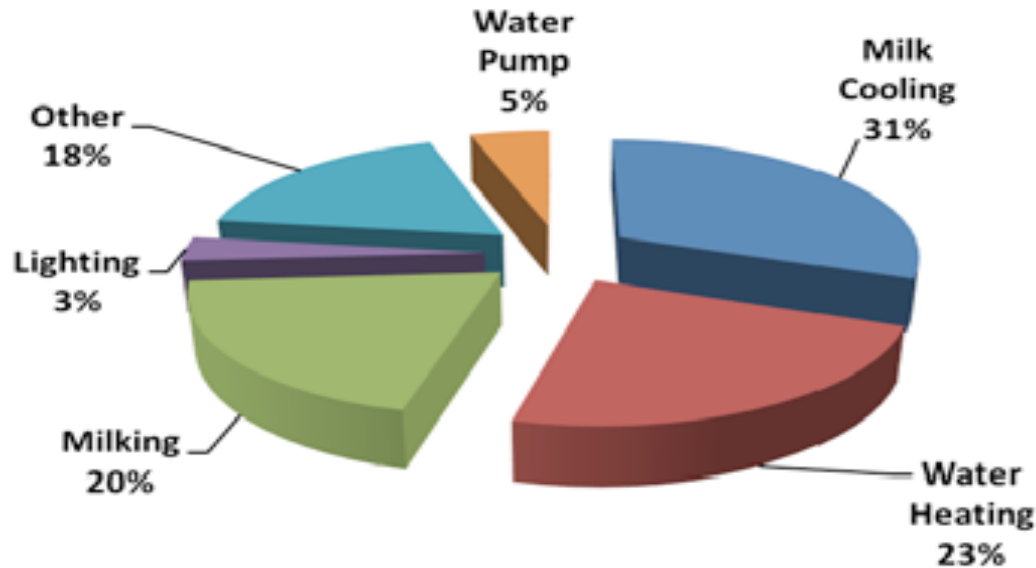


Figure 1. Shows the average component consumption on 60 commercial dairy farms

Cost of electricity = €5.00 per tonne of milk sold

Max = €9.00 Min = €2.50

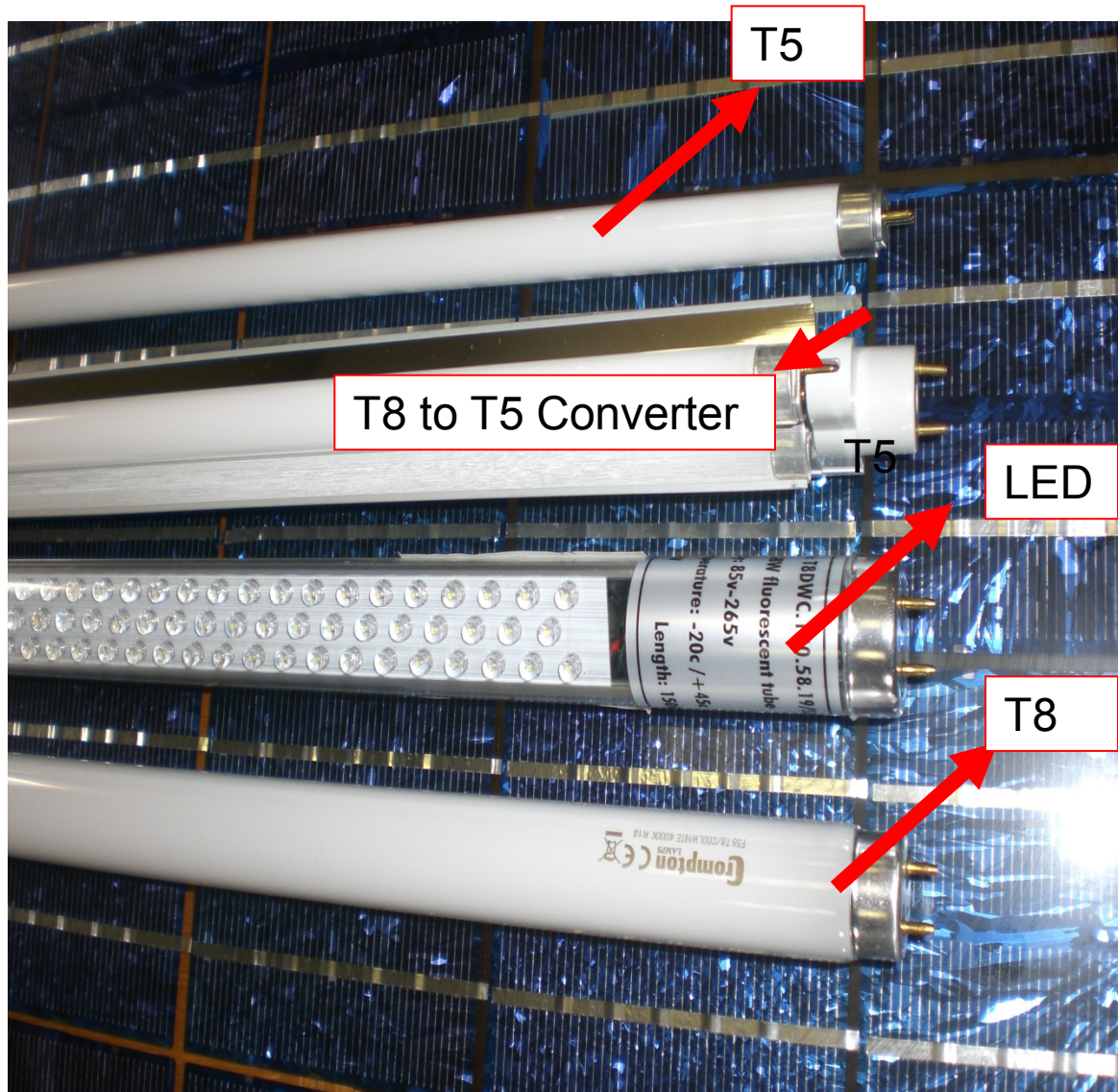
house is on the same meter as the farm.

Night rate electricity

- Day rate = €0.18 / kWh
- Night Rate = €0.085 / kWh
- Free installation, small standing charge
- All electrical water heating should use night rate
- Use timers with battery back up

Energy efficient lighting

- Various light types examined



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 0.437 kg of CO2 per kWh = **203 kg**

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 €260,000
- 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 = 5.4 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 2.9 years

GHG savings in poultry unit

- Emission factor oil = 0.257 kg CO₂ - per kWh
- 1.7m kWh x 0.257 = 437 tonnes of CO₂

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



Photovoltaics



- One kilo Watt Photovoltaic, produces 822 kWh in year one with output declining by 0.7% per year.
 - Average output of 764 kWh per year over 20 years
 - Requires RESS in form of REFIT to support.
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- Using 100% in the business
 - 764 kWh (18.0 cent per kWh) = €137 payback/yr.
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- At a cost of €1,100 per kW installed gives a simple payback of **8.0 years**
 - **TAMS Grant available 40%**
 - **60% for Young Trained Farmers**

PV cuts your Carbon Footprint

- Each kWh of electricity generated by fossil fuels produces around 0.47 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 $16,000 \times 0.47 \text{ kg} = 7,520 \text{ kg}$ of **7.5 tonnes**



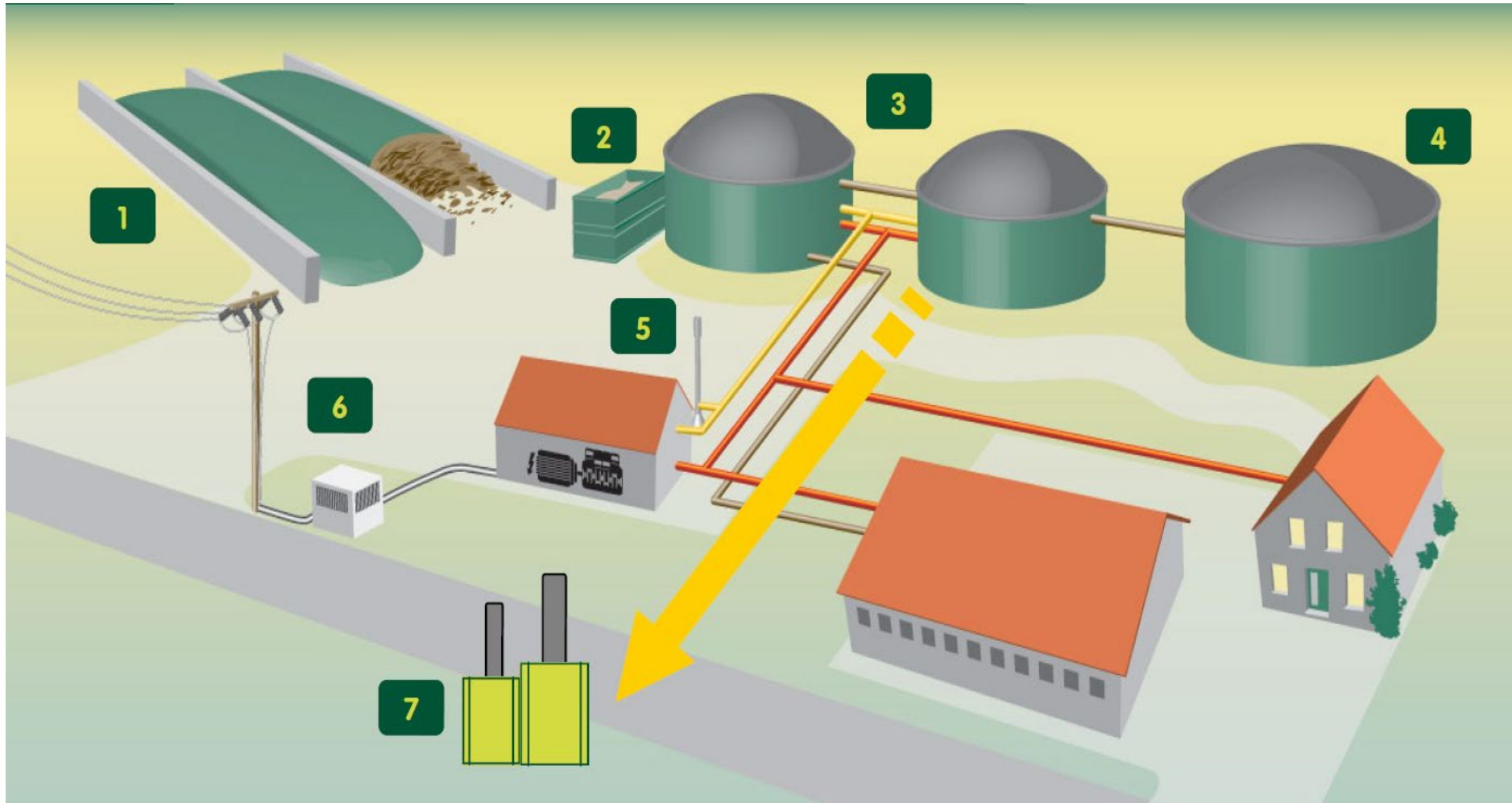
Dairy farm 88 cows - PV

- Consumes 25,252 kWh of energy
- 28% or 7,070 kWh for water heating & pumping
- Additional costs may include diverting electricity to immersion tank and fuse board upgrade

■ ACA

		Cost after grant	
		40% grant	60% grant
Solar PV – 6 kWh	€7,604	€4,562	€3,042
Additional costs*		€1,200	€1,200
Total Cost		€5,762	€4,242
Saving on electricity		€864	€864
Payback (years)		6.7	4.9

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
Total				€29,500

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.