Greenhouse Gas Training Day

Navan – December 2nd 2019

Barry Caslin - Teagasc

Agriculture and Food Development Authority

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.

teagasc
Agriculture and Food Development Authority

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

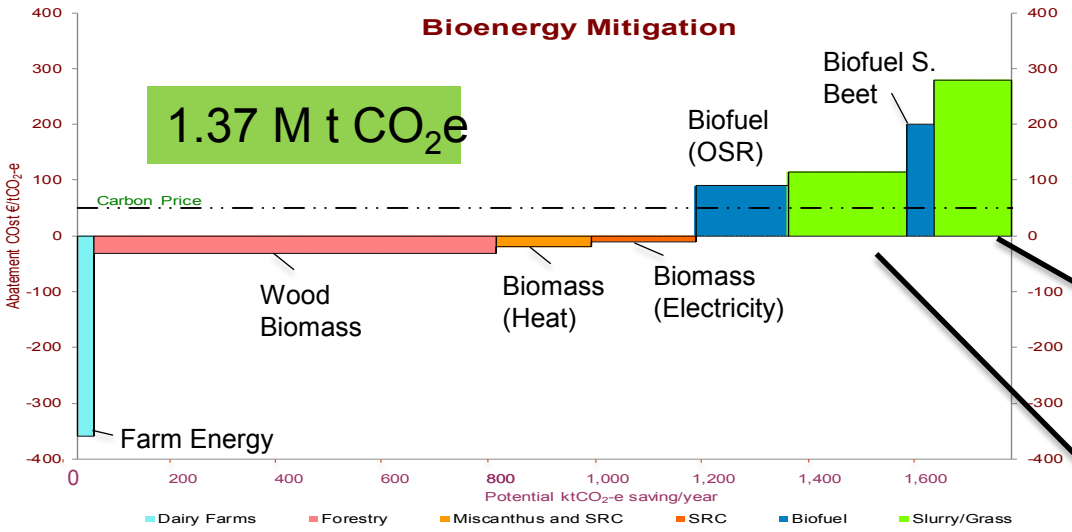
Mitigation of nitrous oxide

- Potential for large N_2O release particularly after ploughing grassland (2 - 4 tonnes ha N_2O 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



Agriculture and Food Development Authority

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 CO_2 per annum
- Assumptions: primarily forestry, 25,000ha biomass crops, grass based AD

CO_2 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 x 0.437kg = 1,748kg or 1.75tonnes of CO2

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 CO2

teagasc
Agriculture and Food Development Authority

Energy use on dairy farms

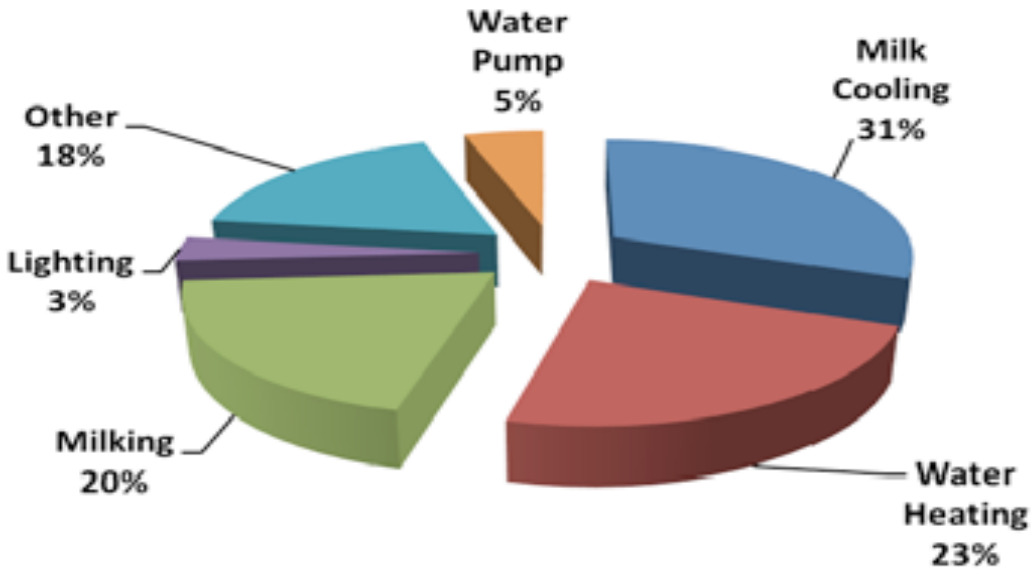


Figure 1. *Shows the average component consumption on 60 commercial dairy farms*

Cost of electricity = €5.00 per tonne of milk sold

Max = €9.00 Min = €2.50

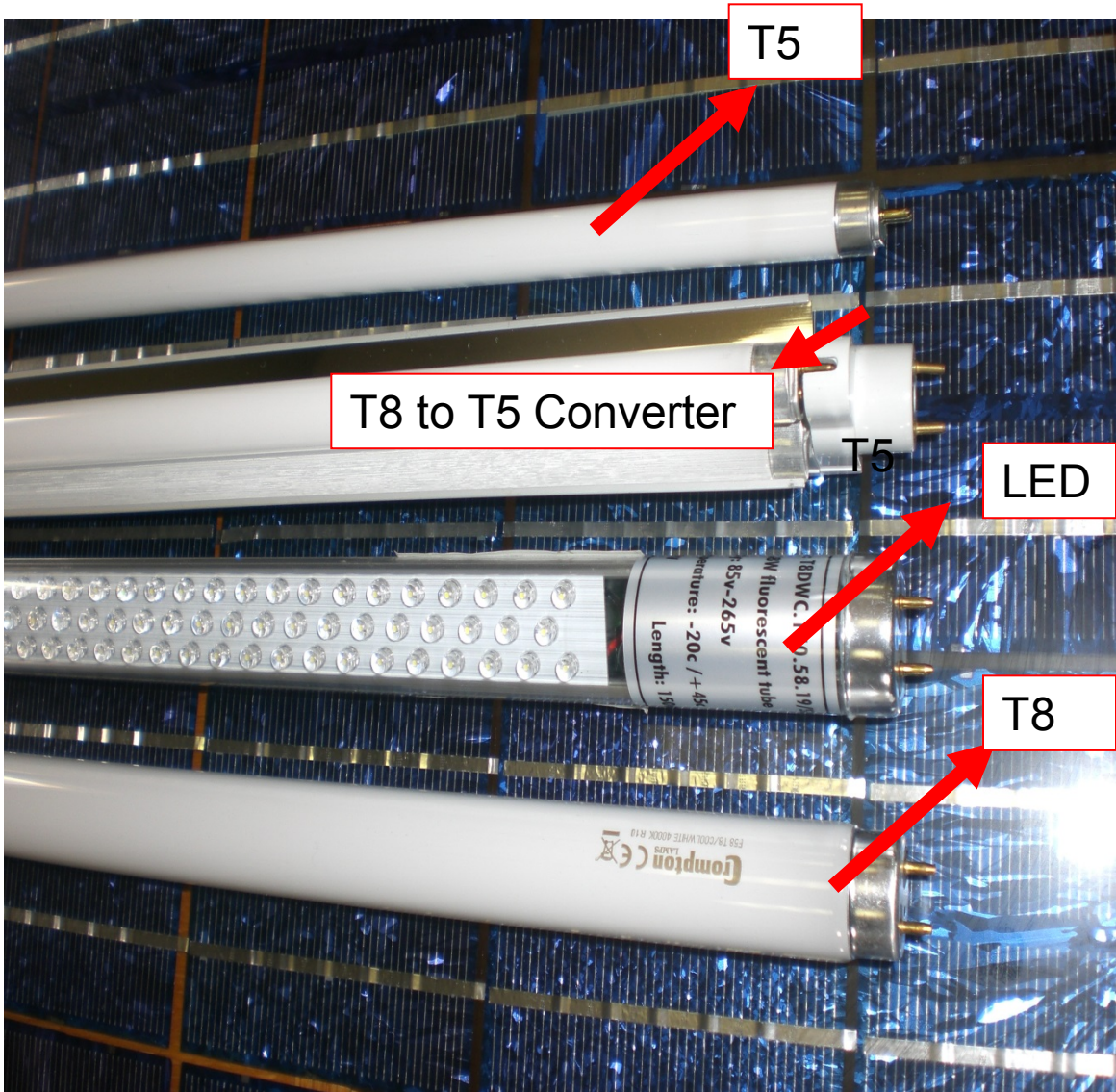
house is on the same meter as the farm.

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**

Teagasc
Agriculture and Food Development Authority

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

teagasc
Agriculture and Food Development Authority

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

Teagasc
Agriculture and Food Development Authority

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.

- Using 100% in the business
- 764 kWh (18.0 cent per kWh) = €137 payback/yr.

- 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

teagasc
Agriculture and Food Development Authority

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 x 0.47 kg = 7,520 kg of **7.5 tonnes**

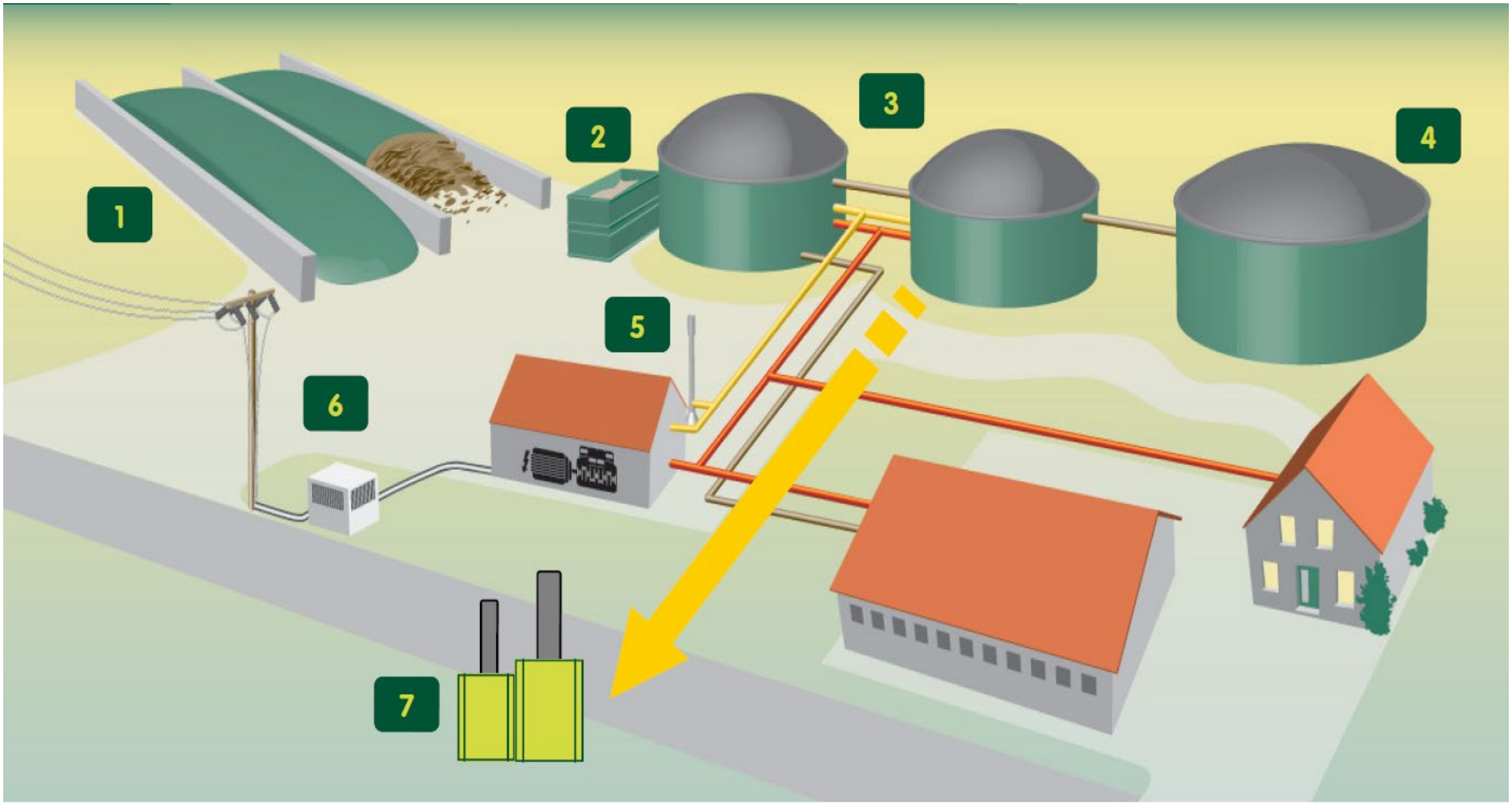
teagasc
Agriculture and Food Development Authority

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



Teagasc
Agriculture and Food Development Authority

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.