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 $\text{N}_2\text{O}$ release particularly after ploughing grassland (2 - 4 tonnes ha $\text{N}_2\text{O}$ 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

Bioenergy Mitigation

1.37 M t CO$_2$e

Abatement CO$_2$e (tCO$_2$e)

Wood Biomass
Biomass (Heat)
Biomass (Electricity)
Biofuel (OSR)
Biofuel S. Beet

Potential ktCO$_2$e saving/year

0
100
200
300
400

Carbon Price

-100
-200
-300
-400

Dairy Farms
Forestry
Miscanthus and SRC
SRC
Biofuel
Slurry/Grass

Biomethane
Biogas

Biomass (Heat)
Biomass (Electricity)

Biofuel (OSR)

Biomethane

Biomass

Biogas

Teagasc Presentation Footer
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
### CO₂ Emission Factor

<table>
<thead>
<tr>
<th>Energy Source</th>
<th>CO₂ emission kg/kWh</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid electricity</td>
<td>0.437</td>
</tr>
<tr>
<td>Natural Gas combustion - Heating</td>
<td>0.205</td>
</tr>
<tr>
<td>Coal - combustion</td>
<td>0.340</td>
</tr>
<tr>
<td>Kerosene</td>
<td>0.257</td>
</tr>
</tbody>
</table>

If I use 4,000 kWh of electricity in the year I’m producing, 4,000 x 0.437kg = 1,748kg or 1.75 tonnes 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.
Energy use on dairy farms

Cost of electricity = €5.00 per tonne of milk sold
Max = €9.00 Min = €2.50

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

<table>
<thead>
<tr>
<th>Cost of LED Lighting and fitting €71 + €4</th>
<th>€75</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy used by LED light</td>
<td>25 W</td>
</tr>
<tr>
<td>Energy used by double fluorescent tubes</td>
<td>116 W</td>
</tr>
<tr>
<td>Hours of light per day</td>
<td>14</td>
</tr>
<tr>
<td>Saving in electricity (116W – 25W)</td>
<td>91 W</td>
</tr>
</tbody>
</table>

At 14 hours per day (14 x 91W)
For 365 days
At 18 cent per kWh / unit of electricity = 465 x 0.18

**CO2 savings 465 x 0.437 kg of CO2 per kWh = 203 kg**

Accelerated Capital Allowances (TAX)
### Biomass heating - SSRH tariff levels
(Cent for each kWh of heat produced)

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

Heat Saving from wood chip + SSRH = €89,550 or payback 2.9 years
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

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

<table>
<thead>
<tr>
<th></th>
<th>Cost after grant</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>40% grant</td>
</tr>
<tr>
<td>Solar PV – 6 kWh</td>
<td>€7,604</td>
</tr>
<tr>
<td>Additional costs*</td>
<td>€1,200</td>
</tr>
<tr>
<td>Total Cost</td>
<td>€5,762</td>
</tr>
<tr>
<td>Saving on electricity</td>
<td>€864</td>
</tr>
<tr>
<td>Payback (years)</td>
<td>6.7</td>
</tr>
</tbody>
</table>
Biogas – 15 year - SSRH tariff levels (Cent for each kWh of heat produced)

<table>
<thead>
<tr>
<th>Tier</th>
<th>Lower Limit (MWh/yr)</th>
<th>Upper Limit (MWh/yr)</th>
<th>Anaerobic Digestion (c/kWh yr)</th>
<th>Amount/yr</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>300</td>
<td>2.95</td>
<td>€8,850</td>
</tr>
<tr>
<td>2</td>
<td>300</td>
<td>1,000</td>
<td>2.95</td>
<td>€20,650</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td>€29,500</td>
</tr>
</tbody>
</table>
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.