



Fuel Switching

What Energy is Right For Me?

barry.caslin@teagasc.ie
Energy in Agriculture
Gurteen Agricultural College
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Overview

- Energy conversion factors
- Energy value of fuels
- Carbon savings
- Steps in fuel switching
- Adding value

Energy conversion factors

To	toe	MWh	GJ
From	Multiply by		
toe	1	11.63	41.868
MWh	0.086	1	3.6
GJ	0.02388	0.2778	1

Energy value of Fuels

Fuel	Net Calorific Value toe/t	Net Calorific Value MJ/t	kWh / unit
Kerosene	1.0650	44,589	10.5 / litre
Peat Turf	0.3130	13,105	3.65 / kg
Milled Peat	0.1860	7,787	2.17 / kg
Peat Briquettes	0.4430	18,548	5.17 / kg
Coal	0.6650	27,842	7.73 / kg
Liquified Petroleum Gas (LPG)	1.1263	47,156	7.09 / litre
Natural Gas			10.2 / m3
Wood chip (35% MC)		13,319	3.7 / kg

Energy Value of renewable fuels

Fuel	GJ/tonne	kWh/kg
Wood chip (28% mc)	13.32	3.70
Wood Pellets (6% mc)	17.45	4.85
Barley Straw	14.83	4.12
Miscanthus (20% mc)	14.29	3.97
Willow (20% mc)	14.25	3.96
1 m ³ of biogas		6.1 kWh

Carbon savings

- Emission Factors

Fuel	t/CO ₂ /TJ (NCV)	g/CO ₂ /kWh (NCV)
Kerosene	71.4	257.0
LPG	63.7	229.3
Natural Gas	56.9	204.7
Coal	94.6	340.6
Milled Peat	116.7	420.0
Sod Peat	104.0	374.4
Electricity (2016)	133.7	482.8

Carbon savings

- 500 kW boiler running for 5000 hours
- 25,000,000 kWh of heat
- If previously using kerosene and moves to wood chip (carbon neutral).
(25m kWh x 0.257)
- Saving = 642.5t of CO₂ per annum

Switching - Steps to be taken

- Calculate the current primary energy use and cost.
- Calculate the current net energy use
- Calculate the primary energy requirement for new wood fuelled boiler.
- Calculate the number of tonnes of wood chips needed to provide the primary energy requirement.
- Calculate the wood fuel expenditure savings compared to kerosene.
- Estimate the capital cost of the new wood fuelled boiler
- Estimate the area of willow or miscanthus required to produce enough wood chips.

Current Heat Use

- If current heat use is oil – 55,000 litres
- @73 c /litre = **€40,150**
- Kerosene has 10.5 kWh/litre
- Annual energy use = **577,500 kWh**

Calculate net energy output

- Oil boiler efficiency
- Assume 80%
- $577,500 \times 0.8 = 462,000 \text{ kWh}$

New boiler primary energy requirement

- If the wood boiler has efficiency of 90%
- Assume 90% of the fuel is converted to heat.
- $462,000 \text{ kWh} / 0.90 = 513,333 \text{ kWh}$ per annum.

Tonnes of wood chip/pellet needed

- 513,333 kWh of input energy
- Wood Chip @28% mc = 3.7 kWh / kg –
 $513,333 / 3.7 = 138738$ kg or **139 tonnes**
- Wood pellets @ 6% mc = 4.85 kWh/kg –
 $513,333 / 4.85 = 105,841$ or **106 tonnes**

Savings in annual expenditure

- Pellets @ €220 / tonne – 106t x €220 = €23,320
- Wood chip @€120 / tonne – 139t x €120 = €16,680

- €40,150 - €23,320 = **€16,830 – wood pellet**
- €40,150 - €16,680 = **€23,470 – wood chip**

Capital cost new boiler

- Design of system
- Boiler kW
- Fuel storage
- Installation

Assume capital cost - €142,500 – 350 kWth

Wood pellet €16,830 = 8.5 years payback

Wood chip €23,470 = 6.1 years payback

Adding Value – Selling Heat

- Example Leisure Centre – 500 kW boiler - €126,480
- Runs for 3,400 hours / yr
- 1,700,000 kWh in 12 months
- Oil displaced = 160,500 litres @ 73c/litre = €117,165 at 10.5 kWh per litre = 7 cent kWh
- Woodchip per annum @ €120 tonne (20% m.c - 4,000 kWh tonne) or 3 cent per kWh = €51,000 / yr
- Yearly saving = €66,165
- Payback without SSRH = 1.9 years
- 437 t of Carbon saved

Energy crops required

- Willow – 20 fresh tonnes per ha / year
50% mc @ 1,900 kWh / tonne =
38,000 kWh / ha

$$513,333 \text{ kWh} / 38,000 = \mathbf{13.5 \text{ ha}}$$

- Miscanthus – 11 tonnes / ha per year
25% mc @ 3,685 kWh / tonne =

$$513,333 \text{ kWh} / 40,535 = \mathbf{12.6 \text{ ha}}$$

Sustainable Support for Renewable Heat (SSRH)

- The Irish Government expects the SSRH to make a significant contribution towards their 2020 ambition of having 12 per cent of heating coming from renewable sources.

Phase one of the SSRH:

- Phase 1: the introduction of the SSRH for non-domestic installations in the industrial, business and public sectors.

SSRH proposed 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)	Anaerobic Digestion (c/kWh yr)
1	0	300	5.66	2.95
2	300	1,000	3.02	2.95
3	1,000	2,400	0.5	0.5
4	2,400	10,000	0.5	0.0
5	10,000	50,000	0.37	0.0
6	50,000	N/A	0.0	0.0

Summary

- Many potential sources of wood for fuel
- Several convenient forms for wood conversion
- The lower the moisture content of the wood the higher the energy content per green tonne.
- Wood energy becomes more competitive as cost of oil and gas increases
- Ireland has the potential to significantly increase its use of wood energy.
- The SSRH will be a game changer

**Thank you
for your attention**

