Fact sheet
Energy 13
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STRAW FOR ENERGY

Introduction

It is accepted that straw is not a prime energy source that will solve the world's energy problems. However, given that straw is a by-product integrated with food production, its potential for use as a sustainable, renewable, alternative fuel source is noteworthy. In addition, increasing straw utilisation will have knock-on benefits to the economy, rural employment and farm income levels. Ireland's area under cereals amounts to almost 270,000 hectares and yields approximately one million tonnes of straw. The traditional markets for straw include animal bedding, animal feed and chopping and plough back to increase soil carbon content. Straw has been used in other EU countries for decades as a combustion fuel for both heat and electricity production.

The Irish government and the EU have made clear their wish to promote the use of increasing amounts of biomass for the production of energy. The value of straw like any resource depends on demand and availability.

Traditionally straw prices have been very volatile, but fixed price contracts are likely to be more attractive to growers now than they have been in the past.

Straw for energy

For the use of straw as fuel, its use in boilers might possibly lead to corrosion problems on heat exchange surfaces. There are a number of boiler manufacturers who will apply their boiler warranty to straw. Straw is a CO_2 neutral fuel and that is the reason why it should be promoted in the energy supply chain. Straw has been used as an energy fuel in Denmark since the early seventies.

Table 1: Cereal tillage areas: Teagasc 2020.

Type	Hectares	t/straw/ha (DM)	t/grain/ha (DM)	t/straw total
Winter wheat	34,679	4.2 (3.6)	9.6 (7.89)	145,651
Spring wheat	11,264	3.0 (2.5)	6.4 (5.28)	33,792
Winter barley	50,688	4.2 (3.6)	8.3 (6.8)	212,889
Spring barley	138,117	3.6 (3.0)	6.5 (5.36)	497,221
Winter oats	8,123	4.7 (4.0)	7.8 (6.4)	38,178
Spring oats	16,435	3.9 (3.3)	7.8 (6.4)	64,096
Total				**991,827**

Table 2: Energy Value of Straw

Type	Calorific value (Mj/Kg)	Energy content (kWh)	Heating oil equivalent (litres~)	Ash content
Wheat Straw	14.4	4,032	396	57
Barley Straw	14.7	4,116	406	48
Rape Straw	14.3	4,004	393	62
Meadow Hay	14.3	4,004	393	71

Source: Teagasc figures.

Straw use

Animal feed and bedding are two uses of straw.

Straw can enter any of the following markets:

- animal feed (barley);
- mushroom compost (wheat);
- animal bedding (oaten, barley, wheaten); and,
- chopping to return to soil (mainly on winter crops).

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13: Straw for Energy

Boilers

There are a number of boilers developed which can handle the more complex chemistry of straw for combustion. Batch-fired boilers are available equipped with combustion air fans to control the air supply. Boiler plants for straw can be used for on-farm heat generation and for district heating. Straw can be presented in chaffed, pellet or whole-bale form depending on the boiler technology.

A straw boiler.

Competing uses

Of the one million tonnes of straw produced in Ireland annually, approximately 60% of this theoretical yield is used on farms as bedding and feed. This figure would have been higher in the past but has reduced due to improvements in farm waste management practices. The next largest user of straw in Ireland is the mushroom composting industry, which uses wheaten straw to produce new mushroom compost. Mushroom compost is manufactured from wheaten straw and poultry manure, with the addition of water and gypsum (calcium sulphate).

Based on the mushroom composition percentages and the amount of compost used in 2011, it is estimated that the mushroom compost industry uses around 85,000 tonnes of wheaten straw produced in Ireland annually (8.5% of the total theoretical straw resource).

Given that the present day combined estimate of straw used for animal husbandry and mushroom composting is around 70% of the theoretical resource of one million tonnes, it is considered reasonable that 25-30% of the theoretical resource (250,000-300,000 tonnes) would be available for energy purposes.

Straw harvesting

Table 3: Approximate bale weights.

Small square bale	15kg
4x4 round bale	150kg
5x4 round bale	240kg
8x3x2 square	150kg
8x4x4 square	450kg

Winter crops of barley, wheat, oats and oilseed rape become available from July to August. The spring-sown crops become available in late August to end of September. Straw is normally baled in round or square bales and transported from the field to storage or directly off farm. Straw may also be recycled to the soil to improve soil structure and increase soil organic matter content.

The 8x4x4 (square) 450kg straw bales used for fuel purposes usually contain 14-20% moisture that vaporises during burning. The remaining dry matter consists of less than 50% carbon, 6% hydrogen, 42% oxygen, and small amounts of nitrogen, sulphur, silicon and other minerals, e.g., alkali (sodium and potassium) and chloride.

Oilseed rape straw

Oilseed rape straw removes fewer nutrients than cereals and so is less 'valuable'. However, it has a high calorific value and burns very well.

Table 4: Chemical properties of straw – source Teagasc.

Straw	Carbon C	Hydrogen H	Oxygen O	Nitrogen N	Potassium K	Calcium Ca	Magnesium Mg	Phophorus P	Sulfur S	Chlorine Cl
Barley	47.5	5.8	41.4	0.46	1.38	0.49	0.07	0.21	0.089	0.40
Triticale	43.9	5.9	43.8	0.42	1.05	0.31	0.05	0.08	0.056	0.27
Rape	47.1	5.9	40.0	0.84	0.79	1.70	0.22	0.13	0.270	0.47
Wheat	45.6	5.8	42.4	0.48	1.01	0.31	0.10	0.10	0.082	0.19

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Further information

For further information please contact Barry Caslin, Teagasc, Rural Economy Development Programme at:
+353 (0)76-111 1213
barry.caslin@teagasc.ie

The following resources are also helpful:
www.teagasc.ie
www.ildn.ie
www.localenterprise.ie/Find-Your-Local-Enterprise-Office/

www.teagasc.ie/ruraldev

Teagasc
Agriculture and Food Development Authority
www.teagasc.ie

This fact sheet was produced by Barry Caslin, Teagasc, Rural Economy Development Programme.