SUBB PROJECT

SUSTAINABLE AND UNDER-UTILISTED BIOMASS BOILER FUELS PROJECT

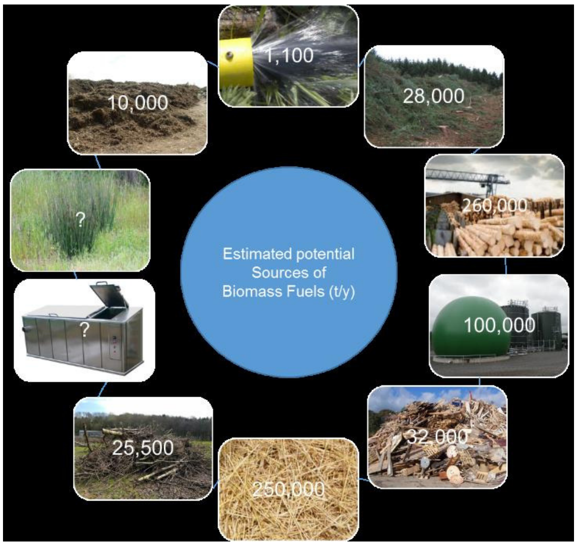

Figure 1. Estimations of Bio-resource availability

PROJECT AIMS

In Northern Ireland approximately 6 % of heat and 27% of electricity is currently generated from renewable sources. While wind and solar are responsible for proving the majority of the renewable electricity, biomass combustion provides almost all the current 6%. However, Northern Ireland must provide 40% of electricity and 10% of heat from renewable sources by 2020 with further development of these sectors required to 2030 and beyond and as such there needs to be significant development in order to reach these goals. It is ever more likely, especially for electricity generation that an increasing proportion of this biomass energy requirement will be satisfied through imports, such as wood pellet from N. America and Canada. There is an opportunity therefore for N. Ireland to take a stake in its own energy future, by utilising previously un-explored purpose grown and incidental agricultural bi-products. Within Northern Ireland there are known to be considerable quantities of biomass materials, for example forestry and aboricultural risings, manufacturing process by-products and agri-food chain wastes, that may have potential as biomass fuels. Findings from a recently commissioned study indicate that there is a possible 700,000 tonnes of these materials available on a continuous basis within the country (Fig 1). However, while many potential fuels may have an energy content comparable with many existing fuels, they may not meet many of the criteria for fuels as set by legislative or industry standards. Thus the principal aims of this project are to test and report on the feasibility of such materials as are presented, using standard laboratory and industry tests to examine and describe their physical and chemical characteristics relevant to biomass energy requirements.

afbi Agri-Food and Biosciences Institute ®

Ulster University

CASE
Centre For Advanced Sustainable Energy

CASE is an Invest Northern Ireland funded competence centre with grant funding of £5 million. The centre has successfully funded 18 research projects in renewable energy across biogas, marine renewables and energy systems sectors.

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PROJECT OUTPUTS

Most biomass boilers operate with fuel delivery systems that use augers or similar mechanical equipment to deliver the fuels, mostly wood pellets or woodchips, to the furnace. These systems generally have limitations on the size of the fuel particles, large pieces can wedge and stop the auger whereas over-abundant small particles can compact within the auger channel and cause stoppages and can also affect the energy conversion efficiency and flue gas emissions of boilers. Conventional biomass fuels, largely wood materials, are therefore graded by size and their quantity within a volume, the composition of which must conform to set standards based on a range of particle sizes, particularly the EU and British Standards (BS EN15149-1; 2010) of classification methods for woodchips and biomass fuels. Fuels provided for SUBB and tested using this method at AFBI Hillsborough, have shown a wide variation in size distribution even in fuels processed using the same production and processing methods. Figure 2 shows the size distributions found within a range of the fuels tested, though there are also potential fuels that consist only of fine or un-densified materials and these will have to undergo further processing for conversion to pellet-form to allow combustion.

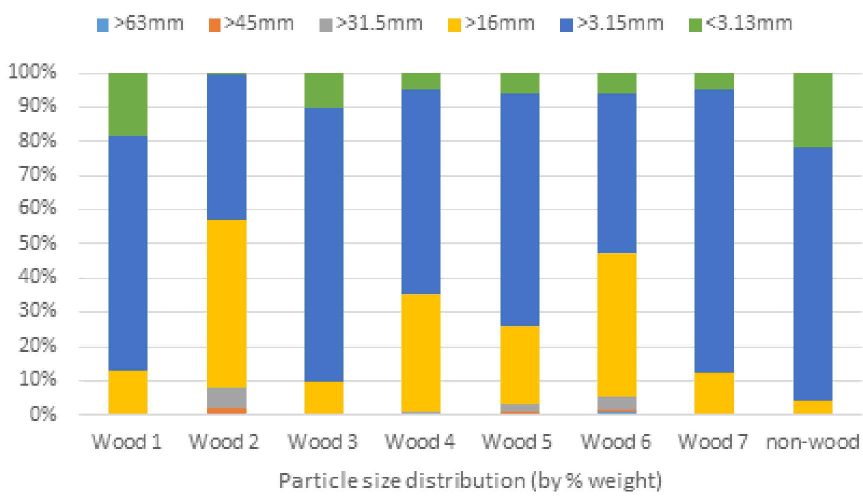

Figure 2. Distribution of particle sizes by percentage weight, found in a range of tested fuels. The fuels are classified by their weight as retained by the sieve sizes. The size categories shown are those applied to biomass supply chain providers for end-user scrutiny.

Potential fuels must also contain sufficient realisable energy, expressed as megajoules per kilogram of dry matter (MJ/kg DM) to justify their use as biomass fuels, not least because of the economics of energy provision but also from a practical need, as the energy producer must do so efficiently and consistently. There may though, be potential to utilise low-energy content fuels to blend with higher energy fuels, especially if the former is a low-cost product that meets the other criteria for biomass fuels. Laboratory analysis allows the determination of the Gross Energy, also known as the Gross Calorific Value (GCV) or the Higher Heating Value (HHV) of current and potential fuels. To assess the GCV of fuels, materials are force dried in ovens until all releasable moisture is driven off, the samples, referred to as dry matter (DM) are then ground down to a fine particle (less than 1.0mm) and are then analysed using the bomb calorimetry method. All potential SUBB fuel materials are subjected to this test and some examples of results are shown in Figure 3. The results show that there is a wide range of GCV within the fuels with a difference of 50% between the top and bottom values. The fact though that the majority are seen to fall within the 15 to 20 MJ/kg DM indicates that these may be acceptable for use as individual biomass fuels on their energy content.

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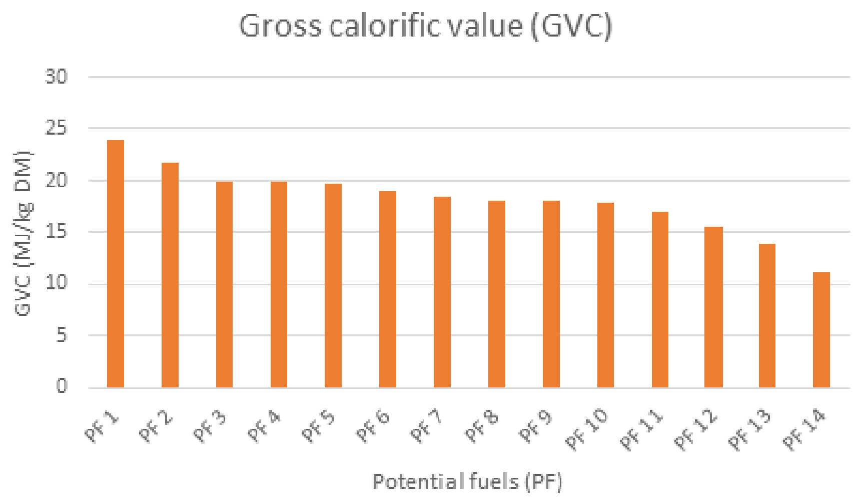

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Table 1. Results of analysis of the concentrations (mg/kg) of elements found within a range of SUBB samples tested at AFBI Hillsborough.

Al	B	Ca	Cd	Co	Cr	Cu	Fe	K	Mg	Mn	Mo	Na	P	Pb	Se	Zn
1068.2	19.2	10765.6	0.0	2.0	3.5	4.3	360.5	4642.7	884.2	30.1	0.4	5293.0	3315.5	1.6	14.1	21.7
650.2	58.5	21521.5	0.3	4.6	2.8	146.0	1181.5	52278.0	6285.0	342.7	4.0	11210.0	8195.6	2.0	21.3	218.5
38.9	24.3	10839.9	1.7	0.6	0.0	4.9	29.1	3128.3	614.9	110.3	< 0.01	292.1	971.1	0.1	8.1	80.7
146.0	23.2	6578.0	1.8	0.8	0.2	3.8	89.6	1949.4	565.2	86.9	0.0	281.1	771.5	0.0	6.4	74.8
2999.1	40.2	41638.4	0.2	7.4	13.9	19.5	3812.7	5646.3	2882.7	240.7	0.9	772.3	2147.2	22.1	24.1	97.2
436.4	32.5	12609.1	0.1	1.5	1.3	8.3	684.7	3832.6	1160.9	46.6	0.8	634.7	589.2	3.0	9.1	43.6
[illegible]	[illegible]	110633.3	0.3	2.7	4.3	53.4	408.2	19954.9	5217.8	326.0	3.4	3190.4	12988.4	1.1	30.1	342.9
29.9	27.8	1296.9	0.1	0.2	0.3	4.1	24.6	11762.1	672.4	38.1	11.4	403.2	800.1	0.8	16.0	19.0
24.1	30.2	3752.3	0.4	0.3	0.3	2.4	23.6	2245.3	389.4	6.8	11.5	186.1	338.8	0.3	18.2	26.9
17.3	31.1	1634.5	0.1	0.2	0.1	9.2	18.8	5371.5	572.7	5.6	11.1	389.4	647.4	0.8	15.6	21.8
43.1	32.9	9105.6	0.1	0.8	1.6	8.1	66.1	3663.4	690.6	9.5	10.8	238.7	979.1	0.2	21.1	28.0
56.4	30.7	2272.1	0.1	0.2	0.2	3.0	22.4	1778.4	425.7	34.5	30.5	285.8	381.2	-0.1	35.2	14.1
17.9	22.5	5538.7	1.8	0.4	0.2	4.7	22.2	2381.9	474.6	19.7	29.8	206.5	872.9	0.2	38.1	71.2
9945.1	29.1	12929.5	0.1	4.3	5.9	9.0	779.8	8186.4	1770.2	130.6	29.0	1485.3	2332.2	5.1	60.2	50.4
56.1	16.2	1183.8	0.1	-0.2	0.4	3.8	69.7	460.2	181.0	67.8	6.2	202.2	56.8	0.9	15.2	21.4
503.5	29.7	5232.6	0.1	1.7	2.4	4.3	420.8	1280.3	597.9	33.9	3.4	322.0	361.6	3.2	17.3	21.4
49.6	15.0	1722.2	0.1	0.1	0.3	1.7	44.8	804.3	282.2	53.9	4.9	174.1	203.5	0.6	14.6	15.1
46.0	23.5	5153.6	1.7	0.4	0.3	3.6	47.2	2867.3	721.8	55.3	2.9	257.8	880.1	0.2	16.8	127.0
29.3	24.4	1109.9	0.1	0.0	0.4	1.8	61.4	549.9	241.5	36.8	3.7	284.5	91.5	0.6	11.7	10.7
30.0	16.9	713.5	0.1	-0.2	0.3	1.1	24.0	390.0	131.2	48.1	3.6	140.5	63.6	0.2	10.6	5.2
93.4	17.1	5504.0	0.1	0.9	0.5	1.5	93.6	1510.9	477.5	9.9	7.8	313.9	231.6	0.4	19.4	4.3
296.8	20.9	7311.5	0.1	1.3	1.1	2.0	232.3	2451.8	718.8	18.5	7.0	377.3	396.7	0.8	21.4	8.9
171.6	23.5	7197.2	0.0	1.6	0.6	3.8	168.8	7241.1	2426.7	227.0	7.3	4046.6	1767.8	0.7	22.0	29.2
127.8	16.4	4122.4	0.0	1.3	0.5	2.0	195.2	5556.3	2364.4	271.0	7.7	1885.7	1313.7	0.5	19.5	27.4
398.7	18.7	3657.4	0.2	0.8	1.0	3.5	264.7	4342.8	1376.6	136.5	1.5	1925.7	1652.4	0.0	15.4	41.5

Table 2. Ash and nitrogen (N) concentration found in a range of SUBB fuels tested at AFBI Hillsborough.

	Fuel 1	Fuel 2	Fuel 3	Fuel 4	Fuel 5	Fuel 6	Fuel 7	Fuel 8	Fuel 9	Fuel 10	Fuel 11	Fuel 12	Fuel 13	Fuel 14
Ash (g/kg)	5.77	43.16	2.02	1.50	53.41	4.01	24.85	3.70	1.99	2.42	3.29	1.66	1.54	21.59
Nitrogen (%)	2.33	3.31	0.47	0.44	1.50	0.59	4.28	0.56	0.18	0.39	0.64	0.30	0.42	0.79

BENEFITS OF CASE FUNDING

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