“The potential for Bioenergy in Northern Ireland”

22nd February 2016

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AFBI Environment and Renewable Energy Centre, Hillsborough
Agenda

- Targets
- Bioenergy sources
- Bioenergy (Fuels, Heat and Power)
- Anaerobic Digestion
- Feedstock and Energy Potentials
- Solid Biomass (Woodfuel)
- Biomass market and fuel demand
- Current & Potential Resources
- Energy Crops? And potential scenarios!
- Further potentials
  - Environmental / Agri / Agrifood
- Conclusions
Targets

• Climate change act to reduce GHGs on 1990 levels
  – 20% EU, 34% UK by 2020
  – 80% 2050
• The N.I. Executive’s current Programme for Govt.
  – 35% reduction in GHGs by 2025
• DETI heat targets (Strategic Energy Framework)
  – To 10% by 2020 (approx 4% by 2015 PfG)
• DETI electricity targets (SEF)
  – 40% by 2020 (approx 20% by 2015)

UK Govt to achieve 15% RE by 2020 (EU RED)

UK Govt to achieve 11% of UK's total primary energy demand from biomass by 2020
Bioenergy refers to the generation of commercially useful energy from biomass.

- Heat
- Electricity
- Fuels

Energy Trilemma!

Opportunities for indigenous supply addressing the trilemma, creating jobs and keeping funds within N.I.
Sources of biomass

• Agriculture
  – Crop residues, animal manures, food processing residues
  – Grains and other starch crops, sugar crops
• Forestry
  – Forestry Brash, mill residues, forest thinning,
• Urban
  – Municipal solid wastes, biosolids, food wastes, green wastes, paper, waste oils and fats, sewage sludge, waste waters (effluents, leachates.)
• Dedicated energy crops (purpose-grown)
  – Trees, SRC, grasses, algae and other aquatic species, microbes, conventional crops.
1\textsuperscript{st}, 2\textsuperscript{nd} & 3\textsuperscript{rd} Generation Biofuels

• 1st generation biofuels  \textit{(sugars, starchs and oils)}
  – Corn – ethanol
  – Soy, rape – diesel

• 2nd generation biofuels  \textit{(lignocellulosic biomass)}
  – Thermochemical
  – Pyrolysis
  – Gasification
  – Torrifiaction

• 3rd Generation  \textit{(from Algae)}

Onus on the fuel suppliers to comply with Renewable Transport Fuels Obligation ensuring a percentage of the fuel they supply comes from renewable and sustainable sources.
Bioenergy for Heat and Electricity Production

• Biomass for combustion / gasification
  – Heat
  – Heat and Power

• Biomass for Anaerobic Digestion
  – the breakdown of organic materials by micro-organisms under controlled conditions in the absence of oxygen.
  – Methane for Heat / Power / Transport fuels
  – Digestate (Fertiliser / Fuels?)
Anaerobic Digestion Feedstocks

- Approximately 10,800,000 tonnes / year (Cattle / Pig / Poultry)
  - Land spreading on grassland is not an appropriate long-term disposal route for poultry litter due to environmental issues and other constraints
  - Phosphate losses via run-off contribute to nutrient enrichment of streams, rivers and lakes (eutrophication), which is an important water quality issue in N Ireland
  - EU WFD & EU Nitrates – SBRI call (SUPL)

- Agricultural crops
  - Grass silage (92% of NI land/high yields/standard farming practice)
  - High agriculture sector GHG emissions (29%) and >90% on NI energy imported
Further feedstock - Biowaste Arisings?

<table>
<thead>
<tr>
<th>Waste</th>
<th>Approx (tonnes / year)</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Municipal</em></td>
<td></td>
</tr>
<tr>
<td>Household</td>
<td>188000</td>
</tr>
<tr>
<td>Sewage Sludge</td>
<td>39,000</td>
</tr>
<tr>
<td><em>Commercial &amp; Industrial</em></td>
<td></td>
</tr>
<tr>
<td>Retail food</td>
<td>35700</td>
</tr>
<tr>
<td>Catering</td>
<td>4140</td>
</tr>
<tr>
<td>Food processing</td>
<td>26000</td>
</tr>
<tr>
<td>Slaughter House</td>
<td>178230</td>
</tr>
<tr>
<td>Dairy</td>
<td>13200</td>
</tr>
<tr>
<td>Drinks</td>
<td>12000</td>
</tr>
<tr>
<td>Animal &amp; Veg waste</td>
<td>145000</td>
</tr>
<tr>
<td>Green &amp; Food Waste</td>
<td>189150</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>830,420</strong></td>
</tr>
</tbody>
</table>

- Large variations according to different sources.
- Current ‘disposal & recycling’ routes include landfill, composting, incineration, animal feed, rendering, land spreading.

Ref; Organic Energy Study (2010); WRAP priority Materials (2012); SWaMP2008 report (2013); Developing Opportunities in Bioenergy (DO-Bioenergy) QUB
Approximate AD capacity

- 2013 – 10 AD plants with installed capacity of approx 4MW
- 2016 – 22 AD plants with installed capacity of approx 10MW
  - Further 16 AD plants mid construction / commissioning

- Significant potential to utilise AD for production of renewable energy and organic waste management.
- Currently difficult to engage much of the waste from commercial, industrial and sewage sludge sectors.
- Agricultural residues, manures and silage can be used with little impact on current agricultural production.
- The total energy consumption in N Ireland (reported by Cambridge Econometrics (2010) on behalf of DETI) was 51.26 TWh. AD can contribute between 2.5 – 11 % of the total energy demand in N Ireland.
Wood fuel demand
## Market & Wood fuel demands

<table>
<thead>
<tr>
<th>% of demand</th>
<th>GWh</th>
<th>(k)Tonnes</th>
<th>Est. Chip</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total N.Ireland Heat demand.</td>
<td>17700</td>
<td>4023</td>
<td></td>
</tr>
<tr>
<td>Including efficiencies.</td>
<td>16700</td>
<td>3795</td>
<td></td>
</tr>
<tr>
<td>2010 base line.</td>
<td>1.7%</td>
<td>284</td>
<td>65</td>
</tr>
<tr>
<td>October 2015.</td>
<td>4.0%</td>
<td>668</td>
<td>152</td>
</tr>
<tr>
<td><strong>November 2015.</strong></td>
<td><strong>6.0%</strong></td>
<td><strong>1002</strong></td>
<td><strong>228</strong></td>
</tr>
<tr>
<td>10% N.Ireland Target by 2020</td>
<td>10.0%</td>
<td>1670</td>
<td>380</td>
</tr>
</tbody>
</table>

*Driven by the RHI.*

- Estimated demand for RHI registered only!
- Massive and growing demand for biomass for CHP
- Drying infrastructure growing demand for fresh chip
- RoI RHI demand for chip (2016/2017) and refit CHP
- Requirement for much more wood chip supply.
- Slow pull through to energy crop planting however for raw indigenous biomass demand largely due to RHI focus.
Current Biomass Resources

<table>
<thead>
<tr>
<th>Managed (ha)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Forest Service</td>
<td>65,000</td>
</tr>
<tr>
<td>Private</td>
<td>20,000</td>
</tr>
<tr>
<td>Unmanaged</td>
<td>20,000</td>
</tr>
<tr>
<td>Willows (SRC)</td>
<td>1,000</td>
</tr>
<tr>
<td>Miscanthus</td>
<td>20</td>
</tr>
</tbody>
</table>

Saw Mill Co-product (300kT)
Energy (200kT)
Board/pulp (30 kT)
Ag/horticulture (56kT)

SRC willow (10kT)
Other potential biomass resources

**Forestry residues;** brash, stump wood, sawmill co-product, arboriculture arisings, waste wood

**Agricultural residues;** straw, husks, reeds, rushes, digestates, composts?

**Crops from bioremediation activities;** **src** willow, energy grasses

Centre for Advanced Sustainable Energy project “Sustainable Underutilised Biomass Boiler-Fuels (SUBB)” (AFBI)

...... **to facilitate the entry into the biomass energy supply chain of underutilised, non dedicated and peripheral indigenous biomass sources ...**
Potential energy crop planting

• Current main contender is SRC willow
  – Suitable to our wet maritime climate
  – Managed disease resistance
  – High Yields
  – Enhanced soil Carbon Sequestration
  – Improved Biodiversity
  – Genetics available from current breeding programmes
  – Rural Employment
  – Profitable agricultural crop
  – Compliant and sustainable Waste Management
  – Improved environmental water quality protection
Exploring the Potential need for planting

Planting to date

<table>
<thead>
<tr>
<th>Year</th>
<th>pre 05</th>
<th>05/06</th>
<th>06/07</th>
<th>07/08</th>
<th>08/09</th>
<th>09/10</th>
<th>10/11</th>
<th>11/12</th>
<th>12/13</th>
<th>13/14</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area (ha)</td>
<td>73</td>
<td>198</td>
<td>195</td>
<td>275</td>
<td>64</td>
<td>37</td>
<td>10</td>
<td>24</td>
<td>30</td>
<td>15</td>
<td>921</td>
</tr>
</tbody>
</table>

- Potential for significant crop establishment due to
  - ultimately increasing oil prices,
  - Energy demand
  - Government incentives (crop establishment & those weighted towards technologies attractive to indigenous fuel supply, fuel sustainability criteria).

- Shortfall in Biomass requirement. Several ways to look at the future with respect to sustainable indigenous biomass supply

- Opportunity / Projections ...!
One scenario for energy crop planting

<table>
<thead>
<tr>
<th>Year</th>
<th>Energy (MWh)</th>
<th>Tonnes (DM)*</th>
<th>land area (ha)</th>
<th>Increased area (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>45938</td>
<td>8750</td>
<td>875</td>
<td></td>
</tr>
<tr>
<td>2015</td>
<td>56963</td>
<td>10850</td>
<td>921</td>
<td>46</td>
</tr>
<tr>
<td>2016</td>
<td>70634</td>
<td>13454</td>
<td>1345</td>
<td>424</td>
</tr>
<tr>
<td>2017</td>
<td>87586</td>
<td>16683</td>
<td>1668</td>
<td>323</td>
</tr>
<tr>
<td>2018</td>
<td>108606</td>
<td>20687</td>
<td>2069</td>
<td>400</td>
</tr>
<tr>
<td>2019</td>
<td>134672</td>
<td>25652</td>
<td>2565</td>
<td>496</td>
</tr>
<tr>
<td>2020</td>
<td>166993</td>
<td>31808</td>
<td>3181</td>
<td>616</td>
</tr>
</tbody>
</table>

* - tonnes at approx 0%MC for fuel consumption

- If the majority (90%) of the increase in biomass requirement will be met by pellets and increasing amounts of forestry and saw mill residues etc
- Approx increasing rate for SRC to supply 10% of the biomass resources to make the 10% renewable heat target by 2020
- Increase in sector employment and supply chain connectivity (land prep, breeding, cultivation, supply, processing, delivery...
Projections to 2050 for change in the areas of land uses

- Current farmed land area in N.Ireland is 998,000ha with 928,000ha of this (93%) being grassland and other hill and rough land;
  - land potentially available for growing energy crops
  - but also to realise multifunctional benefits such as riparian protection, sustainable waste management & biofiltration blocks

- 2% of N.Ireland land area (2% of 1.38m ha) 28,000ha.
  - 28,000ha of SRC willow would yield approximately 1.4TWh
  - Which is 9% of the estimated heat demand (assuming no change in heat demand between 2020 and 2050).
  - However, in the DECC ‘2050 Pathways Analysis’, four trajectories are envisaged which estimate potential land area utilised by energy crops.
**DECC Pathways Analysis - four trajectories**

<table>
<thead>
<tr>
<th>DECC Trajectory</th>
<th>Land area in bioenergy (%)</th>
<th>N.Ireland land area (ha)</th>
<th>Yield (ODT/ha/y)</th>
<th>Total biomass (ODT/y)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A (Current in Ag land use)</td>
<td>5.0%</td>
<td>49900</td>
<td>10</td>
<td>499000</td>
</tr>
<tr>
<td>B (Food focus not RE)</td>
<td>1.5%</td>
<td>14970</td>
<td>10</td>
<td>149700</td>
</tr>
<tr>
<td>C (Focus on reducing GHGs)</td>
<td>10.0%</td>
<td>99800</td>
<td>10</td>
<td>998000</td>
</tr>
<tr>
<td>D (Policy priority to increase domestic bioenergy prodn and C sequestration via woodland)</td>
<td>20.0%</td>
<td>199600</td>
<td>10</td>
<td>1996000</td>
</tr>
</tbody>
</table>

- In all cases it is assumed that the majority of this area would consist of woody biomass crops such as SRC willow.
- Scenario A, even though ambitious, provides 16% of N.Ireland heat requirement (in excess of 10% 2020 target)

Ref: DECC Pathways analysis
The Renewable Heat Incentive (RHI) has been critical to efforts to cut emissions from the UK heat sector (ref. the Department of Energy and Climate Change (DECC) – last week).

• Concludes that the significant growth in the biomass market since 2009 is attributed to
  – the RHI
  – increased consumer and lender confidence
  – the historic increases in oil prices.

• Same is largely true in N.Ireland.

• With a realistic and equitable Incentive, N.Ireland can continue to grow the sector to meet 2020 targets and beyond
  • Large scale installations,
  • District Heating
  • All feeding into indigenous biomass supply with job creation, decarbonisation, energy security and energy cost stability.

Already strong indications of this post November 2015 RHI changes
Further potential in N.Ireland

- Linking of biomass plantations of src willow with sustainable waste management and environmental protection of water quality.

Water Framework Directive
- Water Utility requirement for improving discharges & compliance reducing energy
- Agri-food sector requirement for discharge compliance and protection of the environment.
- Legacy soil phosphorus solutions
Agri - Environment potentials for Bioenergy

- Agri-food sector
  - Increasing outputs (*Going for Growth*)
  - Sustainable Intensification
    - Increasing energy demands
    - Increasing waste management
- Biosolids / Organic waste recycling

- **Recommendation 22** – Govt. must develop a Strategic Land Management Policy, specific to Agriculture ……Whilst enhancing Environmental Sustainability.

- **Recommendation 25** – Govt. must review incentives for renewables to be complementary to the agri-food industry
Farm, Agri-food, municipal and other Applications
Further Environmental Protection

- **Woody Riparian Strips**, placed in the path of “Over Land Flows” to
  - break the flow of water,
  - to precipitate sediment & P
  - provide better biodiversity,
  - carbon sequestration and
  - renewable fuel to heat farm house etc.

- **Woody Biofiltration blocks**, placed downhill of
  - farm yards &
  - at discharges to septic tanks,
  - to catch and filter grey water
Conclusions; Bioenergy and Cross-Departmental wins

- Renewable energy targets, security, cost, local employment
- Agricultural benefits - land diversification, product value chain, sustainability
- Waste water infrastructure - cost reduction, compliance, GHG mitigation
- Environmental benefits – GHGs reduction, water quality, environmental compliance, biodiversity
Thank you

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