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Assessing the cost of biofuel production with increasing penetration of the transport fuel market: A case study of gaseous biomethane in Ireland

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ABSTRACT

Biomethane is an indigenously produced gaseous sustainable transport fuel that uses organic feedstock. Allowing for a realistic collection of organic residues and grass silage from 2.5% of pasture land would allow Ireland to generate 17% renewable energy supply in transport (RES-T) and surpass its 10% target for renewable transport energy by 2020. This would significantly lessen Ireland's dependence on imported fossil fuels, allow compliance with the EU Landfill Directive, and reduce pollution of waterways. Biomethane generated from the organic fraction of municipal solid waste (OFMSW) is the cheapest biomethane (€0.36/L diesel equivalent including for value added tax (VAT) of 21%) This is the least expensive fuel because of the associated gate fee of €70/t. If no gate fee were available the cost would be €1.35/L diesel equivalent including VAT: this underlines the importance of gate fee to what is primarily a waste treatment system. Biomethane from slaughter house waste (SHW) is estimated at €0.65/L diesel equivalent while biomethane produced from grass and slurry is more costly to produce (€1.40/L diesel equivalent). This is still in the cost range of petroleum derived transport fuels at the service station (diesel and petrol prices ranging from €1.38 to 1.45/L in February 2011). OFMSW and SHW can between them provide 1.4% RES-T at a minimum cost of €0.52 /L. To achieve 10% RES-T biomethane will cost a minimum of €1.28/L diesel equivalent. Gaseous fuel can be more competitive by considering a blend of biomethane and natural gas (BioCNG) (e.g. 20% biomethane with 80% natural gas). If natural gas at approximately €0.7/L diesel equivalent is considered, BioCNG will cost €0.82/L at the 10% RES-T target.

Contents

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1. Introduction

1.1. Transport energy in Ireland

In the period 1990–2009 Ireland experienced substantial expansion of the transport sector with an increase in final energy consumptions of approximately 150% over the period [1]. Since 2008 there has been a decrease in transport growth which is related to the downturn of the Irish economy; however transport continues to consume over a third of primary energy and accounts for 41.4% of total final consumption [1]. Imported petroleum products account for approximately 98% of transport energy, while biofuel penetration has increased somewhat to 1.8% of petrol and diesel sales in 2009. To accelerate the growth of renewable energy in transport, the Irish Government recently changed the support mechanism from excise relief on biofuel producers, to a biofuels obligation on transport fuel suppliers. The initial biofuels obligation is set at 4% by volume of biofuel as a proportion of road fuel sold [2] and aims to increase the biofuels proportion to a level that will comply with the 10% renewable energy in transport (RES-T) target for 2020. The Irish government also has a target of 10% electric vehicles (EV's) by 2020; however this is expected to meet only 1% RES-T, therefore biofuels will account for the outstanding 9% RES-T [3].

1.2. Biofuel concerns

Ireland's arable land (9% of total agricultural land) is already fully utilised for food and beverage production and the conversion of permanent pastureland to arable required by most energy crops (such as sugar beet and rape seed) is restricted by EU agricultural policy. As a result the majority of ethanol and biodiesel is imported. Questions pertain as to how Ireland can fulfil its biofuels target and meet the criteria for sustainable biofuels as set out in the EU Renewable Energy Directive [4]. An additional obstacle in developing an indigenous biofuels industry in Ireland relates to the fact that Ireland imports approximately 66% of its transport fuel from the UK [5]. This imported fuel already contains 4% biofuels in accordance with the UK's Renewable Transport Fuel Obligation [6] and by default also fulfils 2.64% of the 4% Irish biofuels obligation. As the UK imports the majority of its biofuel (e.g. 80% bioethanol from Brazil and 38% biodiesel from the USA) [7], there is some concern about the sustainability associated with this practise and the reported negative environmental effects on sensitive eco-systems [8]. As the EU Renewable Energy Directive stipulates that biofuels must not harm sensitive eco-systems it is suggested that national government policy should re-focus attention on the development of sustainable indigenous biofuels.

1.3. Energy forecasts for Ireland

Ireland's energy forecasts for 2020 have been revised a number of times since 2008 [3,9] to incorporate the effects of sharp economic decline but also to allow for energy savings associated with Ireland's National Energy Efficiency Action Plan (NEEAP) and the implementation of the National Renewable Energy Action Plan (NREAP). In the most recent energy forecasts for Ireland to 2020 [3] the baseline scenario for total final energy in transport is 187 PJ, while the NEEAP/NREAP scenario is 178 PJ. The latter assumes Ireland will meet its overall target of renewable energy supply (RES) of 16% and also the renewable energy supply in Transport (RES-T) of 10%. This projection (178 PJ) will be assumed in the analysis below.

1.4. Greenhouse gas emissions and related EU Policy

In 2008, Ireland's major contributor to GHG emissions was agriculture (27.3% of GHG emissions) followed by industry and transport (21.8%, 21.1% respectively) [10]. The European Commission (EC) has proposed new emission targets for 2020 which will replace Kyoto when it expires in 2012 [11]. The target set for Ireland is 20% less emissions by 2020 relative to 2005. This is a significant target as can be evidenced by Ireland's difficulty in meeting its targets under the Kyoto protocol. Ireland's GHG emissions are 26% above the 1990 level [10], while the committed target allows for only a 13.5% increase in GHG emissions.

The EU Renewable Energy Directive [4] has highlighted the sustainability of biofuel production and set GHG savings targets compared to conventional fuels such as petrol and diesel. Article 17 states that "The GHG emission saving from the use of biofuels and bioliquids ... shall be at least 35% ... from 2017 GHG emission savings shall be at least 50%". According to the same directive biomethane produced from wastes and residues readily meet the requirement through GHG savings of 75–85% which may not be said for many first generation indigenous liquid biofuels. As a result many European countries are assessing biofuel systems that will satisfy the required GHG savings and fulfil the sustainability criteria set out in the directive. Ireland's waste disposal problem is increasing with time and according to the EU Landfill Directive [12] alternative waste management options other than landfill must be implemented for over 1 million tonnes of OFMSW by 2016. The diversion of municipal, industrial and agricultural waste towards the production of biofuel will help Ireland to meet the RES-T targets, satisfy the Landfill Directive, reduce pollution and eutrophication and reduce dependence on expensive imported fossil fuels.

1.5. Biogas, a source of biofuel

Biogas is the major energy output from anaerobic digestion (AD), where organic waste and wet biomass (e.g. energy crops) are