Energy Policy 104 (2017) 80–88

Contents lists available at ScienceDirect

Energy Policy

journal homepage: www.elsevier.com/locate/enpol

Investigation of the potential impact of the Paris Agreement on national mitigation policies and the risk of carbon leakage; an analysis of the Irish bioenergy industry

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ARTICLE INFO

Keywords:
Carbon leakage
Greenhouse gas emissions
Paris Agreement
Life cycle assessment
Bioenergy
Ireland

ABSTRACT

A criticism of production-based reporting and accounting of greenhouse gas emissions, as implemented under the UNFCCC and Kyoto Protocol, is the risk of mitigation measures adoption in one country to reduce national emissions, leading consequentially to the displacement of the source activity to other jurisdictions, thus resulting in an increase in net global emissions referred to as "carbon leakage". An important outcome of the 21st Conference of the Parties (COP) to the 1992 UNFCCC may be "plugging" of carbon leakage. This study examined the bioenergy industry in Ireland to determine the extent of existing carbon leakage due to national energy policy and to establish if measures identified within the relevant intended nationally determined contributions will result in plugging of carbon leakage. The study focused on co-firing of biomass with peat, the major use of biomass for energy generation in Ireland. The results show that significant levels of carbon leakage occur due to reliance on imported biomass feedstocks to meet co-firing targets under Irish energy policy. In the post-COP21 scenario, one of the three Intended Nationally Determined Contributions analysed contains a measure which has the potential to reduce greenhouse gas emissions from imported biomass by 32%, highlighting the potential of the Paris Agreement to reduce carbon leakage.

1. Introduction

1.1. International climate change agreements

A common criticism of production based reporting and accounting of greenhouse gas (GHG) emissions, as implemented under the United Nations Framework Convention on Climate Change (UNFCCC) and Kyoto Protocol, is the risk of mitigation measures adoption in one country to reduce national emissions, leading consequentially to the displacement of the source activity to other jurisdictions to meet an on-going market demand (Ostwald and Henders, 2014). Therefore, at best, there is no net reduction in global emissions. It is also often argued that the activity may be displaced to a less efficient economy, resulting in an increase in net global emissions, often referred to as 'carbon leakage'. Carbon leakage is defined as 'an increase in GHG emissions in third countries where industry would not be subject to comparable carbon constraints' according to Recital 24 of the Directive 2003/87/EC as amended in 2009 (European Commission, 2009b). This argument is especially compelling in the situation where there is no commitment across all economies to control emissions of GHGs.

The 21st yearly session of the Conference of the Parties (COP) to the 1992 UNFCCC took place in Paris in December 2015 with the aim of reaching a global agreement on the reduction of climate change (the Paris Agreement). Under this agreement, the COP agreed to hold 'the increase in the global average temperature to well below 2 °C above pre-industrial levels' and pursue 'efforts to limit the temperature increase to 1.5 °C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change' (United Nations Framework Convention on Climate Change, 2016). All parties were required to submit documentation on what actions they proposed to undertaken within their own economies to mitigate climate change. These are termed Intended Nationally Determined Contributions (INDCs). An important outcome from the engagement of all Parties under the Paris Agreement may be a 'plugging' of carbon leakage.

1.2. Irish greenhouse gas emissions and energy policy

The energy sector is the major contributor to GHG emissions in

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http://dx.doi.org/10.1016/j.enpol.2017.01.042
Received 24 May 2016; Received in revised form 15 January 2017; Accepted 24 January 2017
0301-4215/

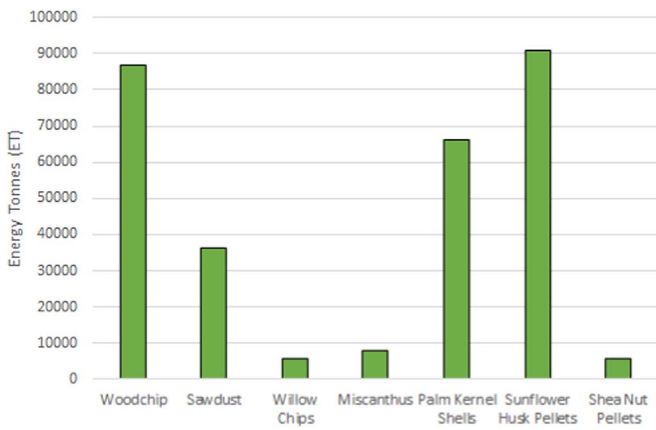

Fig. 1. Biomass combusted in Edenderry power plant in 2014 (Energy Tonnes)[1] (Edenderry Power Ltd, 2015).

Ireland, accounting for 63% (37 Mt CO_2-eq) of total national GHGsemissions in 2012 (Duffy et al., 2014). A key challenge facing the energy sector in Ireland is to moderate its GHG emissions. Ireland is committed, under the European Union (EU) Renewable Energy Directive (RED) 2009/28/EC, to reduce GHG emissions and to develop alternative energy sources to reduce dependence on finite fossil fuel resources (European Commission, 2009a). Ireland's specific requirements under the EU 2020 targets (European Commission, 2009a) are to achieve contributions of renewable energy of 40%, 12% and 10% to electricity (RES-E), heat (RES-H) and transport (RES-T) respectively by 2020 (Department of Communications Energy and Natural Resources, 2010). The majority of renewable energy in Ireland is currently generated by wind, accounting for 71% of the renewable electricity contribution in 2014, with biomass accounting for 8% (Howley et al., 2015). Most of the electricity from biomass is generated by co-firing with peat, to offset peat combustion. Peat combustion produces large volumes of CO_2 directly but also indirectly reduces the carbon budget of indigenous peatlands (Murphy et al., 2015a). Co-firing of biomass with peat is a key element of Ireland's renewable energy policy with the Government mandating each of the three peat-fired power plants to co-fire at a rate of 30% of the maximum rated capacity until 2017, 40% between 2017 and 2019, and 50% thereafter (Department of Communications Energy and Natural Resources, 2010). Under EU legislation (see Section 1.3), biomass used in co-firing in the three power plants can be considered to be 'carbon neutral' for reporting purposes.

Edenderry power plant in County Offaly is the only one of the three peat-fired power plants currently co-firing at an appreciable rate, reaching a co-firing rate of approximately 32% in 2014. Fig. 1 shows the breakdown of the different biomass types co-fired in 2014.

Indigenous biomass (woodchip, sawdust, and energy crops willow and miscanthus) accounted for approximately 45% of biomass co-fired on an energy basis, with the remaining 55% of biomass being imported (Edenderry Power Ltd., 2015).

1.3. Biomass 'carbon neutrality'

Under current EU legislation, biomass used in the generation of electricity, heating or cooling is considered carbon neutral, based on the assumption that the carbon released when solid biomass is burned will be re-absorbed during tree growth (European Commission, 2009a). At present, there are no binding sustainability criteria for biomass at EU level, although some exist at national and industry level. As such, any biomass considered to be a waste (agricultural crop residues including straw, bagasse, husks, cobs and nut shells) used in energy generation are assumed to have a GHG emission balance of zero(up to the point of collection of those materials). This situation is likely to change as EU energy policy develops in the coming years. In February 2015, the European Commission launched an Energy Union package, which will propose a new Renewable Energy Directive for the period beyond 2020, aimed at reaching at least 27% of renewable energy in the EU energy mix by 2030 and setting out a new policy for sustainable biomass (European Commission, 2015).. It is likely that this new policy is will include sustainability criteria for solid biomass that must be satisfied for any electricity or heat generated from biomass to count towards a Member State's overall renewable energy output.

Significant concern exists over the carbon neutrality assumption and the environmental sustainability of large-scale bioenergy deployment compared to other energy options. The production of biomass for energy generation requires the use of fossil energy and raw material in several respects; in the extraction of raw materials (fuels, minerals), in production and transportation of system inputs (seedlings, fertilisers, pesticides), in field operations and transportation, and finally in processing. Large-scale increases in biomass cultivation and energy conversion may pose risks to natural ecosystems by impacting on soil and water resources, causing erosion, air pollution, and biodiversity loss. In addition, the carbon cycle and land use change are crucial aspects of bioenergy systems which require addressing when effectively and comprehensively estimating the environmental impacts of bioenergy systems. Several studies of biomass production systems neglect to consider the changes in soil organic carbon or biomass stock related with land use change or land management. This approach underestimates the impacts of bioenergy systems by failing to consider the effects of land use change and changes in carbon stock in the emission of GHGs from biomass cultivation.

1.4. Carbon leakage induced by climate and energy policy

Several studies have explored the impact of climate change mitigation activities and policies on carbon leakage and indirect GHG emissions. Land-use-change and forestry mitigation have been suggested as mitigation options, however these options may cause shifts in economy-wide or global forest and agricultural activity resulting in carbon leakage if they affect a large proportion of global timber production and consequently prices (Fargione et al., 2008). For example, Sohngen and Brown (2004) reported that the creation of 20 ha of forest set-asides in the US and Europe would consequentially lead to carbon leakage due to 1 ha of inaccessible land elsewhere being converted to forestry. Several policies have been implemented worldwide aimed at mitigating impacts on climate change from the energy and transportation sectors by promoting GHG reductions based on estimates of the life cycle GHG emissions (Plevin et al., 2010). As mentioned previously, efforts in the EU have centred around the Renewable Energy Directive. These targets could potentially trigger direct and indirect effects both within and outside Europe via international trade (Frank et al., 2016), as the EU bioenergy demand will not be covered by domestic production alone (Don et al., 2012). For example, biofuel imports to the EU have grown substantially in the past few years to meet demand for biofuels in transportation; biodiesel is imported from Argentina (soy bean biodiesel) and Indonesia and Malaysia (palm oil biodiesel), with sugar can ethanol imported from Brazil and other Latin American countries (Di Lucia et al., 2012). In fact, palm oil imports from Malaysia and Indonesia increased by a factor of seven from 2005 to 2008, inducing carbon leakage globally as external land use change (Don et al., 2012).

1.5. Life cycle assessment for assessing impacts of bioenergy use

Life cycle assessment (LCA) is comprehensive sustainability assess-

[1] Owing to the varying energy content of biomass commodity types, biomass is quantified in terms of the Energy Tonnes of peat displaced where 1 ET =7.7 GJ.