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Achieving a Greenhouse Gas (GHG) Neutral Ireland

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CCRP Report

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by

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The EPA CCRP Programme addresses the need for research in Ireland to inform policymakers and other stakeholders on a range of questions in relation to environmental protection. These reports are intended as contributions to the necessary debate on the protection of the environment.

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Executive summary

The Climate Change Research Programme aims to provide, in a timely manner, research examining the nature, costs and benefits of ambitious mitigation targets in order to inform long-term planning and policy development. The National Climate Change Strategy 2007 identified the provision of a scientific basis for achievement of a sustainable greenhouse gas emissions profile for Ireland as a key research objective.

This objective has been further defined as GHG neutrality by 2050. This provides an analytical framework for integrated cross-sectoral analyses of a range of scenarios and options to achieve such a goal. This analysis will be linked to ongoing development of analysis to meet existing and likely future targets on GHG emissions and to explore options for achieving significant reductions in GHG emissions in a cost effective and sustainable manner.

The research programme will explore options to achieve GHG neutrality across all sectors and potentials for trade-offs between sectors. This will require development of analysis and integration tools as well as close co-ordination of research across key sectors such as energy, transport and agriculture in order to assess potentials for achievement of neutrality by 2050. It will utilise a range of scenarios to explore the use of sinks, technologies, socio-economic options as well as structures and mechanisms that exist at regional and global level to reduce emissions of GHG.

The competitiveness effects of ambitious targets will also be analysed in the context of emerging international agreements and compared to the costs and benefits of actions in competitor countries. Opportunities for Ireland arising from investments and actions in development of markets and competitive advantage will also be identified.

Achieving a GHG Neutral Ireland

Introduction

Decision-making on actions to address climate change needs to be informed by integrated cross-sectoral analyses of options within an appropriate analytical framework. This framework needs to encompass issues such as the long-term nature of climate change, the imperative of early actions, technologies, and socio economic analyses and competitiveness as well as options and responses of managed and natural systems to enhanced GHG levels.

The National Climate Change Strategy 2007 identified the provision of a scientific basis for achievement of a sustainable greenhouse gas emissions profile for Ireland as key research objectives. In order to better quantify this objective the Climate Change Research Programme (CCRP) has defined sustainable greenhouse gas emissions profile as GHG neutrality by 2050.

This definition provides an analytical framework to assess mitigation potentials on a sectoral and cross-sectoral basis, options and timelines for development and deployment of technologies and assessment of socio-economic tools and solutions. It also provides a framework to advance new technologies and economic solutions and assess options to capitalise on global markets.

Definition of a GHG Neutral Economy

A GHG Neutral economy is one where the net greenhouse gas emissions associated with activity within that economy are zero[1]. The carbon neutral approach does not require all activities or sectors to achieve a carbon neutral status. Rather, emissions associated with one activity would be offset by a sink of carbon from the atmosphere by another. The more GHG efficient the activity, the less the need for offsetting. Note, GHG neutrality explicitly requires robust, verifiable and accountable sinks.

Context

The EU has a stated aim of limiting climate change to an increase in global temperature of $2^{o}C$. According to the IPCC 4^{th} Assessment Report, if atmospheric concentrations GHG reach about 450ppm CO_2 equivalent, global temperatures will have just a 50% chance of staying within this 2^{O} target. Yet even these concentrations would require global reductions in emissions of about 50% on 2000 emission levels by 2050. The burden of stabilising GHG concentrations in the atmosphere cannot be distributed evenly across the globe. At present, the majority of anthropogenic emissions occur in developed countries. In the future, it is likely that emissions from developing countries will

[1] Under IPCC (Intergovernmental Panel on Climate Change) reporting guidelines, only emissions physically occuring within a nation's boundaries are included. Therefore embedded emissions in imported products are not included. However, in a truly sustainable model, efforts would be taken to reduce embedded emissions in imports.

grow significantly. In order to allow this reasonable aspiration of growth in developing countries, developed countries will be asked to make emissions reductions substantially larger than the globally average requirement of 50%. The IPCC estimated the required reductions by Annex I (developed) countries[2] as between 80 – 95% below 2000 emissions by 2050.

The EU aims to reduce greenhouse gas emissions by 20% by 2020, or 30% if sufficient action is taken by the rest of the world. A 30% reduction by 2020 would be consistent with a 450ppm target for 2050. No target has been agreed for 2050. The EU is pursuing its aim of limiting climate change to 2 degrees temperature change in the international arena in UNFCCC negotiations. If the EU is successful, substantial cuts for the developed countries would be agreed. The implications for the Irish economy and society should be understood.

Economic Effects

The IPCC has modelled the global and regional costs of reaching atmospheric concentrations of 550 and 450ppm under different scenarios. At the upper end of the range, these are 3% of global GDP. Costs vary depending on the technology mix assumed, the flexibility of the carbon market and government policy.

Recent work by the Potsdam Institute for the ADAM[3] project on global costs of mitigation shows that it is possible to achieve more ambitious cuts aiming at atmospheric concentrations of 400ppm. The E3MG[4] model shows that this target would have greater benefits than less stringent targets, showing net negative costs of mitigation due to the growth effects of accelerated R&D and investment. How realistic is this result and could it hold true at a country level for Ireland? Other models show that the costs of achieving a 400ppm target are positive though not greater than 1% of global GDP by 2050. If the costs of meeting already agreed EU targets are so expensive, would it be significantly more painful to make more ambitious cuts? In the case of Ireland, if substantial changes are required for even modest cuts in emissions, what is the marginal cost of aiming for more stringent targets?

The fourth assessment report says that the carbon price required to achieve between 450 – 550ppm is \$100/tCO_2e by 2030 [5]. At this price, opportunities may arise which would favour mitigation in excess of targets. How does this carbon price compare with the costs of emission reduction in the different sectors in Ireland? It will be important to understand how the costs of abatement to the Irish economy relate to different long term targets and different levels of international agreement or action. The competitiveness impacts to Irish business and industry of different levels of mitigation ambition under different scenarios of international action are also important. Clearly, if Ireland pursued

[2] The EU, Australia, Belarus, Canada, Croatia, Iceland, Japan, New Zealand, Norway, Russia, Switzerland, Turkey, Ukraine and the United States.
[3] Co-funded by EC 6th Framework Programme; http://www.adamproject.eu/
[4] Developed by 4CMR, based on E3ME by Cambridge Econometrics; described as post-keynesian. R&D is endogenously related to industrial gross investment with an exogenous component determined by government funding policy.
[5] IPCC, Fourth Assessment Report (2007), Technical Summary, p80.

ambitious mitigation in the absence of ambitious global action or a strong global carbon market, there could be severe impacts on Irish competitiveness. However, the competitiveness impacts of Irish mitigation effort are really only a concern where the countries of competitors are not required to make similar efforts. Which Irish sectors are comparatively carbon inefficient internationally and which are most exposed to international competition outside the EU will be important to determine.

To achieve ambitious mitigation targets, a realignment of incentives for individuals, business and government would be required. This can be achieved by cap and trade, carbon taxes, regulation or subsidies. This process of realignment has already begun with the EU emissions trading scheme. However, the broader economy will need to be enabled to consider the costs of GHG emissions in their decision making. This could be achieved by a carbon tax. One important feature of a carbon tax is its potential as an alternative means of revenue raising for government, reducing the fiscal burden on income and corporation tax sources for the benefit of the economy.

Potential for Ireland

The Energy sector, which includes electricity generation, heating and transport, account for 66% of national GHG emissions, 46Mt $CO_{2\ eq}$. At present, 85% of Ireland's energy requirements are met by imported fossil fuels. The rest is met by domestic fossil fuel supply, e.g. peat and natural gas, and renewables. Agriculture (as separate from land-use) accounts for 26% of national GHG emissions, at approximately 18Mt $CO_{2\ eq}$, mostly related to food production for export. Industrial processes and Waste sectors account for approximately 5% and 3% respectively. On the other hand LULUCF[6] including forestry (but not including soils) currently acts as a net sink of 1% of total Irish emissions, with increased afforestation. This is already the subject of policy to maximise its potential. However long term potential of carbon sequestration in biological systems is limited. Clearly, to achieve carbon neutrality for Ireland by 2050, major changes would be needed in the agriculture, transport, heating and electricity sectors.

Agriculture has the potential to be identified as a net sink rather than source, particularly if all activities related to land use (including food production), forestry and the agricultural management practices are integrated into reporting. This could mean that Irish agricultural practices, such as grass-based dairy, beef and bio-energy would be credited as sinks due to uptake of carbon by soils and biomass. Research would be required to ascertain, measure and verify this possibility in order for it to be internationally reportable.

For instance, improved grasslands account for 3.4Mha of agricultural land including areas for pasture, hay and silage. The processes of carbon exchange to grassland soils act over a very long time frame. Ultimately, the soil carbon content of a given soil is the equilibrium state between carbon inputs from plants and other organic material, and carbon losses via decay and other processes. It has been demonstrated that improved grasslands tend towards a higher soil carbon content than

[6] Land-use, Land-use Change and Forestry

similar grasslands in a natural state. The capacity of improved grasslands in Ireland to sequester additional carbon is unknown. However there is evidence that current management practices on well established agricultural grasslands remain a net carbon sink to soils. Although external variables, such as meteorology, have significant influence on the carbon uptake over a given annual cycle, the average uptake on improved grassland is of the order of 1-2t C ha^{-1} per year[7]. Further research is required to verify this result across a range of soils and farming practices. If the results prove valid on a national scale, this represents a significant carbon sequestration potential. The aim would then be to have this potential recognised in international reporting.

Agriculture, forestry and land use will also have a significant role to play in the provision of domestic supply of high carbon content feedstock to the emerging bioenergy and biorefining industry. Diversion of resources away from food production to provide non-food services, including energy, is controversial, especially if it leads to indirect GHG emissions and inappropriate land use change nationally or internationally to overcome the shortfall in food production. However, the reality is that alternative income streams may be a welcome innovation in Irish agriculture.

The practical requirements for decarbonising the **transport** sector need to be assessed. Electric vehicles have made a lot of recent progress and are being heavily supported in Japan and Israel. What is their potential here and what would be the infrastructural requirements and costs? There is also the potential for significant biofuel production for larger, haulage and passenger vehicles, including bio-methane and liquid biofuels. Modal shifts towards public transport can play a part in reducing emissions but such strategies must be aligned with efforts in planning to rationalise demand for transport of all types. Road pricing can play a significant role in reducing demand for transport and in particular in reducing congestion. Road pricing combined with ICT[8] for traffic planning, scheduling and pricing could reduce congestion and emissions with large benefits.

There is scope for improving efficiency in the **heating** sector for both business and domestic users. What are the best strategies in this sector – district heating, electric heating, bioenergy, further improvement in building standards, retrofitting existing housing stock for improved insulation, or renewable sources? Infrastructural planning coordinated with regional or local planning would be required for the deployment of district heating. Planning guidelines could assist or at least enable the deployment of dispersed or centralised renewable heating systems.

Similarly, the use of domestic and business appliances. Energy rating labelling schemes have proven very effective at changing consumer behaviour. The challenge is to ensure that the schemes maintain their relevance, and dynamically respond to the changing product mix.

[7] Byrne K.A., Kiely G., Leahy P. (2007) "Carbon sequestration determined using farm scale carbon balance and eddy covariance." *Agricultural Ecosystems and Environment*. 121 (4): 357-364 UG 2007
[8] Information and Communication Technology

If decarbonisation of sectors is to rely on an **electricity supply**, what is the scope for decarbonising the electricity supply. Is the decarbonisation plan of the ESB[9] sufficient and feasible? The effects on electricity prices and its further impacts on households and business need to be explored. The ESB intends to maintain just a 40% share of the generation market. Therefore new entrants to the energy supply sector must share the low carbon economy visions. Is further public support required to achieve decarbonisation? Can solutions be developed to integrate renewable energy systems, such as wind and ocean, with the network, and overcome the supply issues related to peak demand and inconsistency of generation. There could be significant potential from wave and tidal technologies given Ireland's geographic endowment. What is the potential of micro-generation? Technological innovation is required in energy storage and network structures. It is likely that there will be a significant change in the relationship between consumer and supplier within the Energy sector.

The rate of growth in **Forestry** area in Ireland has decreased in recent years. However, the forestry sector still has potential not only as a sink and store of carbon but also as a source of a renewable fuel, biomass. Coordination between the energy and forestry sectors, and also with planning guidance for heating systems would be important.

Tackling emissions from **Waste** has important co-benefits particularly in the context of the EU landfill directive. The directive can impose significant fines if diversion targets for biodegradeable waste are not met. If efforts are coordinated, significant benefits could be realised in both areas. There may also be opportunities for the production of energy from waste through incineration, anaerobic digestion or more advanced technologies eg. advanced bio-refinery. This would require coordination between planning, energy and waste policy areas. In considering waste, it would also be essential to consider the life-cycle of production and consumption and the embedded emissions or energy of products and services. Irish industry should aim for **sustainable production** aimed at **sustainable consumption** as this will be a growing consideration in international markets. Limits to waste generation will drive new efficiencies in design and manufacture of products and services. It will be important for Irish industry and business to integrate life-cycle analysis to their decision making and to lead the way in identifying ways to make a low-carbon life-style more attractive for consumers in order to gain competitive edge in future markets.

If we assess the costs of decarbonisation, we may uncover opportunities for substantial reductions below the market price for carbon and hence identify opportunities for the sale of allowances or part of Ireland's assigned amount units on the international market.

Technology/Investment

Our research strategy needs to identify and fund opportunities which will lead to viable options for mitigation. This means effective link-up and information sharing between researchers and universities, funding agencies, government and finally the business and finance community.

[9] Electricity Supply Board of Ireland

Technology will be necessary to make significant mitigation achievable but can also offer opportunities for growth in the Irish economy. We need an understanding of what expertise and research capacity exists in Ireland for mitigation options and in particular, areas where Ireland could be a leader. Technological options that are discovered in Ireland should be nurtured as business opportunities and thus contribute to economic growth.

Private sector involvement will be important to development of technologies in Ireland. Significant investment funds are available in the international financial market for sound investments, in particular given the new reluctance to invest in the financial services and traditional domestic construction sectors. Research should be funded to the point where private investment can take over. The private sector should be aware of the research programmes funded by government and should be kept up to date on projects' progress and success rate. Therefore the communication between researchers and entrepreneurs should be strengthened, with improved understanding of the role of each community. Existing bodies, such as SFI[10] and Enterprise Ireland are well placed to facilitate this communication and cooperation and should be involved in the advancement of mitigation technology options in Ireland.

[10] Science Foundation Ireland