

**EPA Climate Change Research Programme 2007-2013**

# **Addressing Climate Change Challenges in Ireland**

**(07-CCRP-3.1)**

## **CCRP Report**

Prepared for the Environmental Protection Agency

by

Environment Research Centre

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## **ACKNOWLEDGEMENTS**

This report is published as part of the Climate Change Research Programme 2007-2013. The programme is financed by the Interdepartmental Committee for Strategy for Science, Technology and Innovation and the Department of Environment, Heritage and Local Government. It is administered on behalf of the Department of the Environment, Heritage and Local Government by the Environmental Protection Agency which has the statutory function of co-ordinating and promoting environmental research.

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## **EPA CCRP PROGRAMME 2007-2013**

Published by the Environmental Protection Agency, Ireland

PRINTED ON RECYCLED PAPER



ISBN: 978-1-84095-473-9

Price: Free

**11/2012/40**

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# Executive Summary

Global and EU policy on climate change is in transition as the first commitment period of the Kyoto Protocol comes to an end and the United Nations Framework Convention on Climate Change (UNFCCC) works to shape a future agreement on global actions to address climate change post-2020. Ireland is also at a critical point in decision-making on how to move to a low-carbon economy and society.

As a Party to the UNFCCC and an EU Member State, Ireland is committed to key climate-protection goals, including ensuring that the average global temperature increase is kept below 2°C. Adoption of this goal implies that developed country greenhouse gas (GHG) emissions will be reduced by 80–95% relative to 1990 levels by 2050. Consideration of 2050 goals is therefore essential for planning and achieving the mitigation targets established under the EU 2020 Climate and Energy Package (CEP).

## European Union 2020 Targets

The EU 2020 CEP is a step forward in moving to an emissions pathway consistent with the 2°C goal. However, the current GHG emissions reduction target of 20%, relative to 1990 levels, by 2020 is not in line with the scientific analysis of what is required to achieve the 2°C goal. A step-up in ambition to a 30% reduction, which is envisaged in the context of comparable international action, would be in line with that goal.

The CEP also established an EU-wide Emissions Trading Scheme (ETS), with a reduction target of 21% and a non-ETS emission reduction target of 10% both relative to 2005 levels by 2020. The non-ETS target covers, *inter alia*, transport, agriculture, heat and waste. The non-ETS target was allocated to EU Member States in the Effort Sharing Decision 2009/406/EC (ESD) (EU, 2009). Ireland has an ESD emissions target of 20% below 2005 levels by 2020.

## Towards 2050

Climate policy development needs to be viewed from the perspective of the 2050 mitigation goals. The EU 2050 Roadmap outlines how collective EU GHG

emissions can be reduced by 80% relative to 1990 by 2050 (EC, 2011). This provides a template for analysis of emissions pathways for Ireland. The United Nations Environment Programme (UNEP) provides an alternative 'GHG neutrality' template, which aims to achieve net-zero emissions at a future date.

Ireland's GHG emissions profile is unique within the EU in that emissions from the agriculture sector comprise almost 30% of total emissions. Projections of future emissions suggest that Ireland will exceed its ESD target by 2017 and may have a cumulative excess of emissions of 2–20Mt by 2020. Further actions will be required to address this overshoot. These actions need to be informed by 2050 goals.

Application of the EU 2050 analysis to Ireland can be used to envision a low-emission Ireland by 2050, which is coupled to green economic development and low-carbon enterprises. This suggests that the energy/power-generation sector would be effectively decarbonised by 2050, with only residual emissions being allowed in the transport and heating sectors. To be cost-effective, this transition process requires early action.

Emissions from agriculture would be reduced by 50% by 2050. Agriculture would then totally dominate Ireland's emission profile, with total emissions being of the order of 10Mt per annum. It is not yet clear how significant reductions in agricultural emissions can be achieved without changing production levels. However, this is an area of global research and innovation. Engagement and support for such research initiatives in agriculture are needed.

A carbon-neutral approach provides an alternative perspective on future emissions. This would include the recognition of the value of carbon sinks. Initial analysis suggests that the full potential of currently unaccounted for sinks would be of the order of 9Mt per annum. If this were realised through sustainable management, then a carbon-neutral Ireland may be achievable via domestic actions supplemented by a limited offset purchasing programme through international market mechanisms. Actions to ensure that these sinks are subject to required

measurement, reporting and accounting systems and suitable management systems are required.

Sectoral mitigation strategies are intrinsically interlinked and need to be developed in an iterative cross-sectoral basis, for example a land-use strategy to 2050 would facilitate a coherent approach to evolving requirements in the agriculture, forestry, biofuels and ecosystem services. This should be consistent with spatial planning and development strategies.

## Policy Options

Analysis by the European Climate Foundation (2010) suggests that a shift in investment patterns towards low or zero carbon technologies and infrastructure in areas such as power generation is required by 2015 to avoid the higher costs associated with locked-in technologies and infrastructure. The current carbon price is insufficient to promote such a shift in the EU ETS sector. An increase in ambition in the ETS sector could increase the carbon price and incentivise the required structural shift. This would mean increased auction revenues for government and co-benefits, for example in increased energy security.

Applying a carbon price to a wider set of GHG emissions in the non-ETS sectors would encourage greater activity in these sectors. Other sector-specific options exist, which include regulation, labelling and incentives. These need to be implemented in an effective manner if reduction targets are to be achieved.

The enablement of private-sector engagement in mitigation actions – particularly in the non-ETS sectors – is also needed. Domestic offsetting or project approaches to mitigation can activate required private-sector innovation with economic and enterprise benefits. Domestic project-type approaches to mitigation could inform policy-makers about additional mitigation techniques and improve future policy-making.

Market mechanisms within Europe and internationally will play a role in mitigation scenarios for Ireland. However, a purchase-based compliance strategy for 2020, even if unit costs are low, would be costly in the long run by missing the potential benefits from early domestic mitigation efforts. Successful domestic mitigation would reduce long-term compliance costs, reduce government revenue spent abroad and benefit

the domestic economy. It could also support the development of new green enterprise. Co-benefits from domestic actions include increased energy security, improved air quality and enhanced resource efficiency.

## Global Finance and the Green Economy

Agreement to mobilise US\$100bn annually by 2020 for climate action in developing countries was part of the outcome from the UNFCCC meeting in Copenhagen, 2009. Ireland will have to contribute to climate finance obligations up to and beyond 2020 as part of this commitment. While mobilisation of this finance will be challenging, it also provides opportunities as a new international market for climate products and services. Given current government fiscal constraints, attention needs to focus on mobilising private finance for international climate actions as part of the US\$100bn commitment. This could also have entrepreneurial benefits for Ireland, e.g. adding further support to the development of initiatives such as the Green IFSC (International Financial Services Centre).

Government could develop an enterprise strategy to benefit from new markets for climate goods and services in developing countries. A focus on developing countries needs would be a key pillar of this strategy. These include the use of renewable energies, observation systems, water and agricultural services.

With foresight, Ireland can be a world leader in climate information and service provision and particularly in significant niche areas such as agricultural services. However, a national goal and strategy to turn scientific excellence into creation of climate services and solutions, including consultancy and education services, is required.

New economic opportunities will arise from the demand for climate solutions – both in terms of mitigation and of adaptation. These will give rise to green growth and job creation. Ireland can be positioned to be a leader in climate solutions. However, steps are required to enable this, including:

- Building Ireland's reputation internationally in climate science and innovation;
- Adopting a pro-active approach to climate policy, including credible and ambitious domestic mitigation efforts;

- Engaging the private sector in climate action, encouraging innovation, for climate solutions;
- Engaging strategically at international fora and with global partners.

Green credentials are particularly important when competing in high-end international industries, such as food products and exports. Improving the green brand for Ireland will also increase the attractiveness of Ireland for foreign direct investment and for the location of international and European headquarters of large companies.

Cross-departmental coordination and engagement will be necessary to advance national goals effectively. Enterprise strategy for the green economy would draw on the expertise and relationships developed in engagement with the UNFCCC and the Intergovernmental Panel on Climate Change (IPCC), and in international development activities to advance green enterprise development at home.

## **Recommendations**

A cross-government climate change vision for Ireland is needed. This would mainstream actions to progress medium- and long-term mitigation goals into sectoral and national development goals. This needs to be coupled with strategies for green enterprise and development and linked to the key international processes for the development of global actions. Elements of this could include:

- An objective of a 'GHG-neutral Ireland by 2050';
- Support for increased ambition in the EU ETS to 2020;
- Identification of market opportunities from international policy developments;
- A strategy to engage the private sector in domestic and international climate action;
- Targeted research and innovation to support the green credentials and market position of Ireland.

This would establish Ireland as a leader in combating climate change and enhance Ireland's green reputation.



# 1 A Shared Goal: 2020 Targets and Aiming for 2050

## 1.1 Introduction

Global and European Union (EU) policy on climate change is in a transition phase. The first commitment period of the Kyoto Protocol is coming to an end. A yet to be fully defined second Kyoto Protocol commitment period is imminent while the UN Framework Convention on Climate Change (UNFCCC) has entered into a new negotiation process on the shape of a future global agreement on actions to address climate change.

As a Party to the UNFCCC and an EU Member State, Ireland is committed to key climate goals, including to:

- Prevent dangerous climate change through actions to reduce greenhouse gas (GHG) emissions in line with the 2°C temperature goal;
- Participate in funding actions on climate change in developing countries of the order of US\$100m annually by 2020;
- Support and utilise emerging institutions and structures that enable effective actions on climate change;
- Meet targets established under the EU Climate and Energy Package (CEP).

Ireland also aims to achieve national goals in sustainable development, economic advancement and international engagements. National actions on climate change effectively entail a major socio-economic transition to a sustainable, resource-efficient and climate-friendly Ireland by 2050. Resilience to a changed local and global climate regime will also be important for Ireland in 2050.

Elements of this have been identified, including: current emissions targets for 2020, the concept of the green economy and its associated opportunities for enterprise, as well as the emerging structure of a global climate agreement. However, a more complete vision of the Ireland of 2050 or the process by which the required transition will occur have not yet been defined.

Steps are therefore required to enable the development of a planned transition to a low-emission climate-resilient Ireland by 2050. This report is focused on the

transition to a low-emission Ireland. It outlines critical issues and options for key elements of climate policy development. The approach taken is to:

- Focus on 2050 mitigation goals;
- Explore domestic climate policy options;
- Consider options to advance a green economic model for Ireland.

Section 1 presents the international context, and charts the structure and nature of the challenge arising from the GHG emissions limits established under the EU2020 CEP.

In Section 2, emissions pathways to 2050 are outlined. These are based on the EU 2050 Roadmap and related analysis from national and international sources. The concept of a 'GHG-emissions neutral' Ireland by 2050 is used to consider options in meeting ambitious long-term goals.

Section 3 discusses policies to meet mitigation commitments, including market mechanisms. Approaches to address emissions both within and without the EU Emissions Trading Scheme (ETS) are explored, and dynamics between the two elaborated. Developments in the international carbon market are also examined.

The future development of the international negotiations under the UNFCCC and economic opportunities are considered in more detail in Section 4. These are considered to be increasingly important to Ireland's response to climate change. The role of and goals for financial transfers to developing countries for climate actions will also be explored. Conclusions are provided in the final section.

## 1.2 Preventing Dangerous Climate Change

In the 1992 UNFCCC, world governments recognised the threat of anthropogenic climate change and agreed to work to prevent dangerous climate change by stabilisation of atmospheric GHG concentrations. The 1997 Kyoto Protocol established GHG emissions

targets for developed countries. These were recognised as being insufficient to achieve the objective of the UNFCCC. However, implementation of the Kyoto Protocol would:

- Provide proof that developed countries, having greater historic responsibility for emissions, would lead on actions to address climate change;
- Establish key elements of the global architecture required to enable action on climate change, including accounting structures;
- Set up regional and global market mechanisms.

It was not until 2007, following publication of the Intergovernmental Panel on Climate Change (IPCC) 4th Assessment Report (AR4), that Parties to the UNFCCC focused on achievement of its objective, that is the 'stabilisation of greenhouse gases in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system'. The 2007 UNFCCC Bali meeting and subsequent meetings in Copenhagen in 2009 and Cancún in 2010 took major steps in the development of a clearer shared goal on how to prevent dangerous climate change.

### **1.3 A Shared Global Goal**

Article 2 of the UNFCCC states its objective to prevent dangerous climate change but does not specify how it would be achieved. The 2009 Copenhagen Accord included a goal to ensure that the increase in global average temperature did not exceed 2 degrees Celsius (2°C) relative to pre-industrial levels. This had been an EU position since 1997 (EU EG Science, 2008).<sup>1</sup> This goal was fully adopted internationally at the UNFCCC meeting in Cancún, 2010. Its adoption has implications for all Parties to the UNFCCC.

The IPCC AR4 provided analysis of a range of GHG stabilisation levels and their implications for the average global temperature. The AR4 analysis indicated that, at an atmospheric concentration of the 450ppm CO<sub>2</sub> equivalent, the average global temperature increase would have a 50% chance of staying below 2°C. The AR4 also outlines indicative pathways for the achievement of the 450ppm CO<sub>2</sub>e stabilisation level as shown in [Table 1.1](#).

1 [http://ec.europa.eu/clima/policies/international/negotiations/future/docs/brochure\\_2c\\_en.pdf](http://ec.europa.eu/clima/policies/international/negotiations/future/docs/brochure_2c_en.pdf)

The AR4 analysis indicates that global emissions should peak by 2020 at the latest and achieve emissions reductions of about 50% on 2000 levels by 2050. The EU report *The 2°C Target* states that 'global emissions have to peak by 2015–2020, and to decline rapidly until 2050 and beyond' (EG Science, 2008). Greenhouse gas emissions from developed countries should be reduced by 25–40% relative to 1990 levels by 2020. Developing country emissions should also depart from a business as usual (BAU) trajectory by 2020. In order to allow reasonable aspirations for access to energy, economic growth and an improved standard of living in developing countries, the AR4 suggests that developed countries need to make emissions reductions substantially larger than the global average requirement of 50%.

This analysis informed the targets in the EU's 2020 CEP, i.e., the 20% emissions reduction by 2020 and more particularly the proposed step-up in ambition in the context of a global agreement. [Table 1.2](#) shows current emissions reductions proposals which have been tabled by the EU and a number of large Annex I developed-country Parties to the UNFCCC. Mitigation pledges by the developing country Parties (Nationally Appropriate Mitigation Actions) are not in the form of absolute reductions from a fixed baseline and so are not reflected in the table.

To date, the sum of pledges made by Parties to the UNFCCC under the Copenhagen Accord and more formally in Cancún in 2010 do not constitute a sufficient level of ambition to achieve the 2°C goal (United Nations Environment Programme [UNEP], 2010).

### **1.4 The European Union 2020 Targets**

The December 2007 CEP includes a target to reduce its collective GHG emissions by 20% relative to 1990 levels by 2020. As [Table 1.1](#) shows, a reduction of 25% or more by 2020 is needed to be consistent with a 2°C limit. The CEP included a step-up option to a 30% reduction if comparable action is taken by the rest of the world, i.e. in the context of a global agreement.

The CEP also replaced the existing system of linked national ETS, in which emissions caps were set by each Member State with an agreed EU-wide ETS cap in 2013 (see [Table 1.2](#)). Under the CEP the EU will impose an annual 1.74% decrease in issuance of EU allowances

**Table 1.1. Mitigation commitments by selected countries.<sup>2</sup>**

	Base year	2020	2050 <sup>†</sup>
IPCC developed country cuts required to keep 2° target in reach	1990	25–40%	80–95%
IPCC developing country actions required to keep 2° target in reach		Substantial deviation from baselines in Latin America, Middle East, East Asia and Centrally-Planned Asia	Substantial deviation from baseline in all regions.
EU	1990	20% (30%*)	At least 80%
USA <sup>3</sup>	2005	17%	83%
Australia	2000	5–15% (25%*)	
Canada	2005	17%	
Japan	1990	25%*	
Norway	1990	30% (40%*)	
Switzerland	1990	20% (30%*)	

\* Offers conditional on other country actions/progress in the UNFCCC negotiations.

† Targets for 2050 are generally aspirational and do not have the same status as 2020 targets.

**Table 1.2. The climate and energy package (CEP).**

	Annually to 2020	2020 target
EU		-20% from 1990
Emission Trading Sector (ETS)	-1.74%	-21% from 2005
EU non-ETS	Linear decrease	-10% from 2005
Ireland non-ETS	Linear decrease from 2013 to reach target in 2020.	-20% from 2005

so that annual EU ETS emissions will be capped at 21% below their 2005 levels by 2020. The EU ETS is applied to large single-point emission sources.<sup>4</sup>

Emissions from other sources remain the responsibility of the Member States. The CEP established an aggregate EU-wide 10% reduction on 2005 levels for these non-ETS emissions. Non-ETS emission targets were allocated to each Member State. Ireland, along with Denmark and Luxembourg, took on a target of a 20% reduction relative to 2005 levels by 2020. This is the highest non-ETS emission target. In 2007 the European Commission (EC) estimated that this equated

to a reduction of 37.9MtCO<sub>2</sub>e in 2020 and would cost Ireland in the region of 0.5% of GDP in 2020 (EC, 2008). Currently, the EPA estimates that the mitigation required in 2020 will be 37.5MtCO<sub>2</sub>e (EPA, 2012).

#### 1.4.1 Step-up to 30%

The EU CEP contains provisions within its directive and decisions for negotiation of a 'step-up' in ambition to a 30% reduction by 2020 in the context of a global agreement on climate change. While such an agreement is not yet in place there have been calls for the EU to unilaterally step-up to 30%. Reasons to do so include:

- The 2020 20% target is inconsistent with the EU and UNFCCC 2°C goal. The 'step-up' would clearly be in line with this goal;
- Cyclical reductions in EU emissions linked to reduced economic activity have largely removed the need for structural change to meet the 2020 targets. Many installations are simply scaling back production;

2 Appendix I to the Copenhagen Accord, UNFCCC as at August 2012.

3 Whitehouse Press Office, 2009.

4 The EU ETS covers some 11,000 installations in 30 European countries. It includes power generation, combustion plants, oil refineries, iron and steel works as well as large-scale cement, glass, lime, bricks, ceramics, pulp, paper and board production. It is discussed in more detail in Section 3.1 below.

- The low demand in the carbon market has global consequences for mitigation actions as mitigation projects in developing countries are less attractive.

European Climate Foundation (ECF) analysis suggests that 'the 2050 goals will be hard to realise if the transition [to a low-carbon energy system] is not started in earnest within the next 5 years' and that 'waiting until 2015 (or later) to begin to build the large amount of required infrastructure would place a higher burden on the economy' (ECF, 2010). This concern is particularly keen for the EU ETS sector where energy supply and industrial emissions are controlled, and current carbon prices are weak.

The 30% reduction target would increase the carbon price and push the structural change for a low-carbon economy, consistent with the original aim behind the CEP. Without real structural change, emissions will rise unsustainably when EU economies recover.

### **1.5 The Second Commitment Period of the Kyoto Protocol**

The agreement in Durban 2011 that a second commitment period of the Kyoto Protocol will begin in January 2013 will add another layer of legality to EU targets, but should not impact materially on Irish and EU mitigation requirements. The length of the commitment period, whether it ends in 2017 or 2020, is planned to be agreed in Doha, Qatar, 2012. There are other important technical aspects of the second commitment period still to be agreed, such as the carry-over of assigned amount units from the first commitment period. While this last point should not affect EU ambition, where internal targets and allowed flexibilities have already largely been agreed, it will impact the international carbon market and thus the ambition of non-EU countries. It will also have financial implications for those EU Member States holding excess units for compliance from the first commitment period.

### **1.6 A Long-term Perspective, towards 2050**

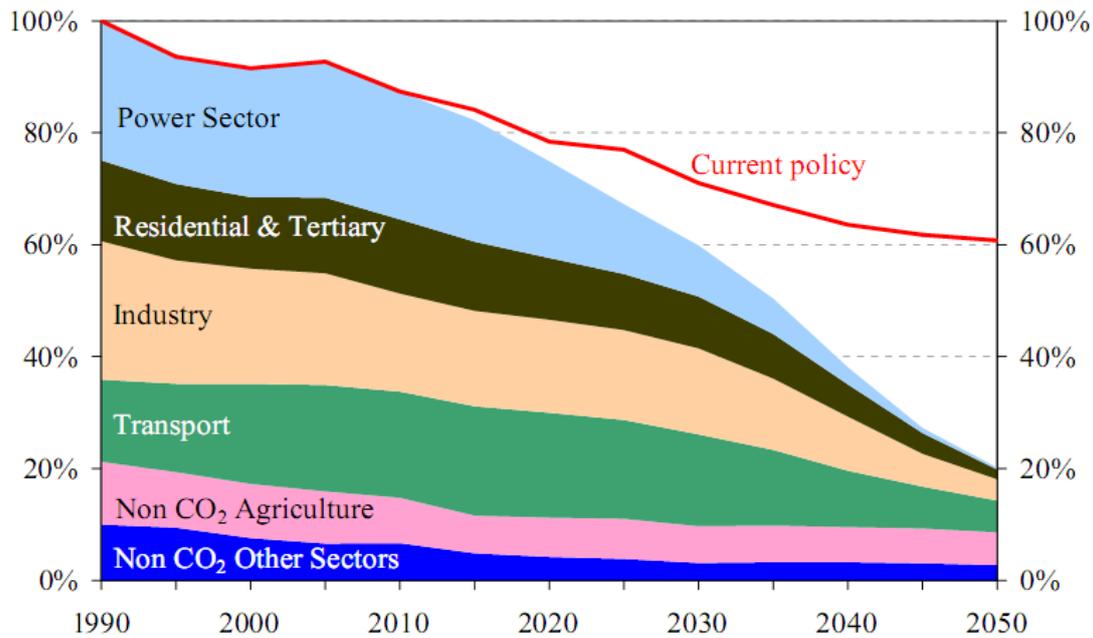
The discussion in Section 1.3 above shows that the 2020 emission reduction targets have been established in the context of longer-term mitigation requirements

beyond 2020 and at least up to 2050. The *Review of National Climate Policy* published by the Department of Environment in November 2011 suggested that 'Policy decisions must ... consider the costs and benefits of implementation on (at least) a twenty year horizon' (DoEHLG, 2011).

Decisions taken now will materially affect emissions pathways up to and beyond 2050. This is most critical for investments in infrastructure and buildings and for directing research and development (R&D) investment. Existing examples of the long-term impacts of decision-making include: Moneypoint which locked Ireland into coal-fired power generation for decades or the Ardnacrusha hydroelectric dam (1929) which was a significant contributor of renewable energy in Ireland. More broadly, London and Paris Undergrounds built in the nineteenth century continue to provide an alternative to the private car for millions of commuters.

The AR4 states 'large-scale energy-conversion [power generation] plants with a life of 30–100 years give a slow rate of [capital] turnover of around 1–3% per year. Thus, decisions taken today that support the deployment of carbon-emitting technologies ... could have profound effects on GHG emissions for the next several decades' (Sims et al., 2007). Moreover, 'there is a large stock of existing and inefficient buildings, most of which will still be here in 2025 and even 2050. Ireland's long-term ability to reduce energy use depends critically on the extent to which energy use in these buildings can be reduced when they are renovated' (Levine et al., 2007).

Long-term target-setting affects investors' decisions on long-life assets. A robust long-term target for GHG emission reduction will increase the expected net present value (NPV) of GHG efficient assets (compared to low efficiency assets) via the market or shadow price of carbon (discussed further in Section 4.3 below). A robust long-term target is as a result essential for required low-carbon investment. It also increases the incentives for investment in research, technology development and innovation. Ireland, the EU and the international community should adopt robust and specific long-term emission reduction goals to 2050.



**Figure 1.1. European Union greenhouse gas (GHG) emissions towards an 80% reduction on 1990 levels (EC, 2011).**

## 1.7 The EU 2050 Roadmap

In 2011 the EC published a communication 'A roadmap for moving to a competitive low-carbon economy in 2050' (EC, 2011). This states that 'the transition towards a competitive low-carbon economy means that the EU should prepare for reductions in its domestic emissions by 80% by 2050 compared to 1990', excluding international offsets. [Figure 1.1](#) is taken from the EU 2050 Roadmap and shows how various sectors are envisaged as contributing to achievement of the required emissions reductions by 2050. Section 2 considers how these are reflected in Ireland.

The analysis shows that the most cost-effective pathway to 80% emissions reductions by 2050 (consistent with the 2°C goal) is emissions reductions of at least 25% by 2020 (EC, 2011). This analysis has been considered by EU heads of state but has not been adopted.

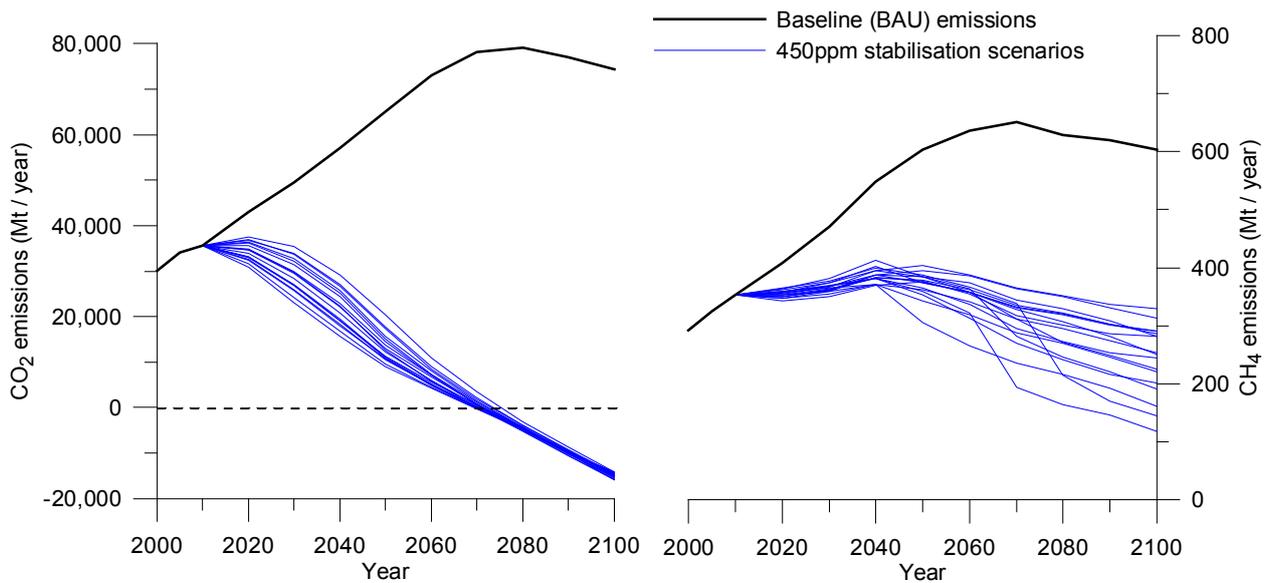
## 1.8 Carbon-neutral Goals

The EPA Climate Change Research Programme (CCRP) established GHG neutrality by 2050 as a framework for development of longer-term analysis of options to manage GHG emissions and sinks (O'Reilly, 2008).

The aim is to identify strategies to achieve the greatest ambition, at a feasible cost, by taking a holistic approach to mitigation possibilities rather than focusing on current emission accounting rules. A GHG-neutral economy is one where the net greenhouse gas emissions associated with activity within that economy's geographic area are zero.<sup>5</sup> It is important to note that GHG neutrality would require robust scientific verification of sinks and high standards for offset mechanisms.

The AR4 and subsequent policy-related publications by the EU have focused on the emissions reductions relative to a base year, typically 1990. This has been enshrined in the UNFCCC under the Kyoto Protocol. There has been movement away from using 1990 as the base year: EU CEP targets focus on 2005. There are various reasons for this, including the lack of data for certain gases and activities in 1990 and some disquiet among some UNFCCC Parties about the arbitrary nature of 1990 as a base year. Many of the

<sup>5</sup> The IPCC (Intergovernmental Panel on Climate Change) reporting guidelines address emissions within a nation's boundaries only. Embedded emissions in imported products are not included. Sustainability models may include efforts to identify and reduce embedded emissions.



**Figure 1.2. Illustration of global emissions pathways for carbon dioxide and methane consistent with a 450ppm stabilisation level. Significant negative emissions are required in the second half of this century BAU = business as usual, (Resigner et al., 2012).**

Copenhagen Pledges also provide different base years for reduction targets.

A number of countries have established carbon neutrality as a goal. The United Nations Environment Programme (UNEP) has established a Carbon Neutral Network, which includes countries, regions, provinces and cities from around the world who have declared their aim to become climate neutral in the next decades through, *inter alia*, renewables, carbon taxes, energy efficiency and carbon offsetting (UNEP, 2012). Separately, Sweden is developing a roadmap 'towards an emissions neutral economy' by 2050. The analysis published in February, 2012 by the Swedish EPA identified scenarios to reach the 2050 goal. An early conclusion is that the Swedish energy system would have to almost completely decarbonise by 2050 (Government of Sweden, 2012).

The analysis in [Fig. 1.2](#) shows a range of emissions pathways to achieve the goal of limiting climate change to at most 2°C above pre-industrial temperature levels. The analysis suggests that globally net zero emissions of CO<sub>2</sub> are required by c. 2070. This means that a carbon dioxide, or wider GHG neutrality, is needed. Establishment of such a goal enables a forward-looking analysis of the management of both GHG emissions and sinks.

## 1.9 Conclusions

An international process to determine an appropriate global approach to climate change is under way under the UNFCCC: a key element of this has been the adoption of the 2°C goal. This adds definition to the UNFCCC objective to avoid dangerous climate change. This report is focused on the implications of the 2°C goal for GHG emissions pathways to 2020, 2050 and beyond.

The 2°C goal implies achieving a number of milestones into the future, including a global peaking of emissions by 2020 and the halving of global emissions by 2050. Early action is required to avoid lock-in of high-carbon technologies, which would jeopardise achieving these milestones. Early action can be enabled by adoption of a long-term approach to climate policy and planning, including the adoption of targets out to 2050. Options to meet targets are considered in more detail in Section 3.

The EU 2050 Roadmap outlines options to reduce pan-European emissions by 80% from 1990 levels by 2050 in line with the 2°C target. A broader concept of carbon neutrality has been advanced by UNEP. These provide a template for analysis of options for mitigation options for Ireland. This is considered further in Section 2.

## 2 Ireland's Greenhouse Gas Emission Pathway Options

### 2.1 Introduction

The EPA provides annual inventories of Ireland's greenhouse gas (GHG) emissions. This is a requirement under the UNFCCC. The national GHG inventories are subject to international review and assessment. Since 2008 these inventories have been the basis for accounting of emissions under the Kyoto Protocol and used to determine compliance with the targets established under the Kyoto Protocol and within the EU.

National GHG emissions inventories also provide the main basis for the development of policy and the prioritisation of mitigation actions to reduce emissions. The national inventory is the base for official projections of future GHG emissions by the EPA. As the inventory development system is in itself subject to development and improvement, the national inventory also informs research requirements to enable an improved assessment of activities and processes that give rise to GHG emissions.

In this section, current and projected GHG emissions are assessed to identify options for Ireland in moving to a 2050 goal such as that outlined in the EC 2050 Roadmap. This section also examines the goal of GHG or carbon neutrality by 2050 and the state of knowledge on its feasibility for Ireland.

### 2.2 State of Play of Emissions in Ireland

In 2011 Irish emissions were approximately 57.34MtCO<sub>2</sub>e, about 4% above 1990 levels. This means that Ireland is on target to meet its Kyoto Protocol target to keep its emissions to under a 13% increase relative to 1990 emissions.

The 2011 data shows that Ireland continues to have a unique emissions profile within the EU because emissions from agriculture make up about 32% of total emissions. Other key sectors include energy (20.8%) and transport (19.7%). For the 2013–2020 period large-scale power generation and industry will be included in the EU ETS. As [Fig. 2.1](#) shows, the largest share of emissions in Ireland falls outside the ETS. The non-ETS emissions are mainly agriculture, transport, residential and waste.

The 2012 EPA emissions projections for Ireland indicate that based on 'with measures' (WM)<sup>6</sup> and 'with additional measures' (WAM)<sup>7</sup> scenarios – the distance to the 2020 Irish non-ETS target could be as much as 4.1 to 7.8MtCO<sub>2</sub>e by 2020 with a cumulative excess of 2–20Mt over the period (EPA, 2012).<sup>8</sup> The lower end of the range (WAM) assumes that all planned measures, policies and targets are fully and optimally implemented and have achieved their full abatement potential.

In the ETS sector, emissions for 2020 under a WM scenario are projected to be 16.6Mt or approximately 25% below 2005 levels.<sup>9</sup> Under the WAM scenario, 2020 emissions in the Irish ETS sector are projected to be about one-third below their 2005 levels.

The projections show that, if all currently planned mitigation measures deliver to the full, Ireland's emissions will exceed ESD annual limits in 2015 or 2016, with a cumulative excess of some 5–30Mt likely by 2020. There are flexibilities in the ESD allowing limited use of credits from Community-level projects, certified emission reduction units (CERs)<sup>10</sup> and the transfer of annual emission allocations between Member States. Assuming a price of €10/tonne CO<sub>2</sub>e and reliance on the use of credits or allocations to bridge Ireland's gap to target, the overall cost of these flexibilities could be in the order of €50m to €300m in the period to 2020, and potentially considerably more beyond 2020. Therefore, actions which can be taken domestically should be encouraged for their potential to reduce compliance costs up to and beyond 2020.

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6 With already existing and legislated for policies and measures.

7 Including existing and *planned* policies and measures, including targets not yet associated with measures.

8 EPA (2012) *Ireland's Greenhouse Gas Emission Projections 2011–2020*, [www.epa.ie](http://www.epa.ie)

9 The 'with measures' and 'with additional measures' scenarios include the impact of a carbon price via the EU ETS.

10 Further explained in [Box 3.2](#).

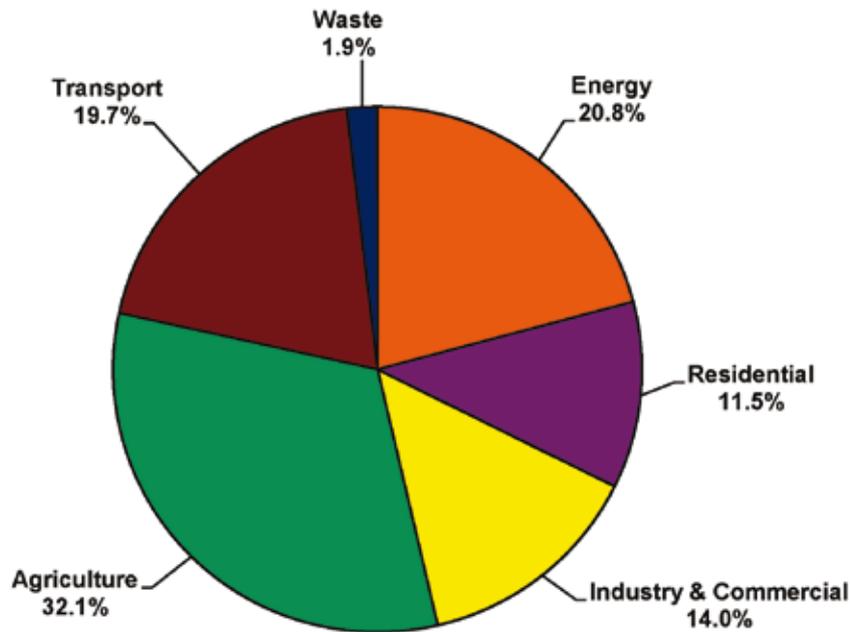


Figure 2.1. Greenhouse gas (GHG) emissions in 2011 by sector, provisional release (EPA, 2012).

## 2.3 Mitigation to 2050

The EU 2050 Roadmap aims to inform EU Member States how the EU might collectively meet an overall 80% emissions reduction target by 2050 relative to 1990 emissions. This provides a template for the analysis of the mitigation challenges for key sectors in Ireland as presented in [Table 1.1](#) and Section 2.4 below.

## 2.4 Key Sectors

### 2.4.1 Power Generation

The early adoption of low-carbon technologies by the sector is essential if lock-in to high-emissions technologies is to be avoided. In Ireland, renewable electricity supply reached 13% in 2010 but substantially more is required on the road to 2050 (ESB, 2009; SEAI, 2011).

In the long term, technological and business innovation is needed in energy storage smart grids and other distribution and management technologies to enable the use of renewable resources (SEAI, 2011). Innovation is required to move to a business model based on the provision of a service (e.g. light, warmth and/or miles) rather than energy units. The best-known models for these are the Energy Service Company model (ESCOs) or Pay as You Save (PAYS) models for domestic energy-efficiency improvements. Energy-efficiency improvements normally require up-front investment

costs, but in both these cases, the company bears the upfront costs while the consumer pays for the improvements in instalments, which should be less than the savings achieved in domestic energy costs. In electricity networks, business innovation may be required to cope with increased percentages of renewable energy. This could be done, for instance, by paying power generators for ancillary services besides actual energy delivery, for example payment for availability of back-up generation for intermittent renewables (operating reserve), black start capability, secondary frequency regulation, etc. Eirgrid, the national electricity transmission network operator already pays for some ancillary services. Irish TIMES analysis suggests that demand for electricity will grow to 2050 bringing in new markets from electric vehicles and potentially space heating (Ó Gallachóir et al., 2012). Export potentials can also facilitate renewable investment. The Sustainable Energy Authority Ireland's Wind Energy Roadmap foresees a considerable contribution of wind to a low-carbon energy supply and also, via wind energy exports, to the green economy (SEAI, 2011).

Energy efficiency will continue to be important in meeting near-term mitigation targets and in facilitating meeting longer-term energy demand to 2050. Appliances continue to increase demand. Energy rating labelling schemes have influenced consumers. Maintenance and enhancement of these schemes is required.

#### 2.4.2 Carbon Capture and Storage

Carbon capture and storage (CCS) technologies will be essential for elements of industry or power-generation sectors that require large-scale use of fossil fuels. Carbon capture and storage with biomass is one of a limited range of options for large-scale negative emissions. Through the Sleipner project, CCS has been trialled in Norway, where Statoil has a commercial operation to separate CO<sub>2</sub> from natural gas close to source and re-inject it beneath the seabed to avoid paying a carbon tax. However, CCS has not yet been demonstrated at scale. The EU, China, Norway and the US are investing in improving the efficiency of CCS technologies and demonstrating their potential. Approval for one of the world's first commercial-scale CCS operations was given in Canada in 2011, to be commercial by 2014 (Saskpower, 2011).

The EC recently gave a positive 'Opinion' on a draft national permit for CCS offshore in the Netherlands.<sup>11</sup> The Dutch government is expected to issue the permit, allowing the project to become the first large-scale CCS plant in Europe.

The Environmental Protection Agency, SEAI and Geographical Survey of Ireland (GSI) studies of CCS potential in Ireland suggest that the depleted off-shore gas fields in the Kinsale basin are the most promising (2008).<sup>12</sup> However, the cost of CCS needs to be factored into planning in the electricity and industrial sectors: these include planning for new plant, piping and other necessary infrastructure. Due to the cost and remaining technological uncertainties in CCS, alternative uses for the separated and highly concentrated CO<sub>2</sub>, for example as a raw material in valuable products, may be a commercially attractive way to address residual GHG emissions after all other mitigation options have been applied.

#### 2.4.3 Agriculture

Ireland is unique in the EU, not only for the high share of emissions from agriculture but also because of the nature of the agricultural activity that takes place.<sup>13</sup> In

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11 [http://ec.europa.eu/clima/news/articles/news\\_2012022901\\_en.htm](http://ec.europa.eu/clima/news/articles/news_2012022901_en.htm)

12 [http://www.seai.ie/News\\_Events/Press\\_Releases/Storage%20of%20CO2%20Report%20Sept%2008.pdf](http://www.seai.ie/News_Events/Press_Releases/Storage%20of%20CO2%20Report%20Sept%2008.pdf)

13 In 2010, agriculture was less than 10% of emissions in the EU (EEA, 2012).

Ireland livestock farming with grazing is the dominant system for production. The potential for emissions reduction is considered to be less than the European average of up to 49%. The development of mitigation options applicable to Ireland is a priority. The existing mitigation potential is considered to exist in waste management: this may include measures such as anaerobic digestion, reduced or zero tillage, and production-efficiency measures. These can have financial gains for the agriculture sector.

A recent report from the Joint Research Committee (JRC) indicates the potential for approximately 20% reductions in GHG emissions from agriculture in Ireland, in line with EU 2020 targets (Fellmann, 2011). However, the scenarios presented are either within the context of EU-wide regulation, emission trading or effort-sharing arrangements. It is not clear the extent to which emissions reductions are achieved 'in country', and therefore the extent to which they can be applied to Ireland is uncertain.

Though sinks such as forestry have not been included in the EU 2050 Roadmap, elements of forestry, discussed further below, are accountable sinks under the Kyoto Protocol. Other land-use types are subject to election by Parties, and Ireland has not elected other land-use types.<sup>14</sup> Agriculture and land use have well-documented sinks of carbon to biomass and soil which are directly associated with activities which have accountable emissions. Future accounting for all activities related to land use (including food production), forestry and agricultural management practices may better reflect the real net GHG emission from this sector.

The future share of land use between energy, food production and various ecosystems services will be a key factor in determining the overall GHG emissions balance for Ireland.

#### 2.4.4 Forestry

The high rate of afforestation in Ireland – on average about 10,000ha per annum since the early 2000s – is unique in the EU. However, the forestry sector still has potential not only as a sink and store of carbon but also as a source of a renewable biomass, which in the long

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14 Accountable emissions and sinks under the Kyoto Protocol are those which are counted towards compliance with emissions targets.

Table 2.1. Sectoral analyses (various sources).

Sector	EU 2050 RoadMap pan-European analysis (relative to 1990 by 2050)	National analysis	Key technologies	R&D gaps, requirements
Energy/power generation 21.8%, 13.36Mt	93–99% Emissions reduction Almost 100% low-carbon technologies are required by 2050	Renewable energy made up 13% of the electricity supply in 2010 (ESB, 2009, SEAI 2011) National target of 40% renewables by 2020 ESB Neutral by 2035* Irish TIMES: 96% emission reduction possible by 2050	Wind energy (Irish TIMES; 70% of electricity supply, SEAI; 40+ GW capacity) Energy efficiency Gas with carbon capture and storage (Irish TIMES; 18% electricity supply) Smart grids Ocean energy	Use of smart grids and storage to support increased share of renewables CCS commercial demonstration Measures to reduce demand Business model innovation
Heat/residential 12.7%, 7.82Mt	88–91% Largely decarbonised by 2050.	Irish TIMES: 93% possible by 2050 SEAI Roadmap: 90% possible by 2050	Energy efficiency (SEAI, Irish TIMES) Improved build and insulation standards Electrification of heat (Irish TIMES; 40% of heat demand) Renewable energies (Irish TIMES; 25%)	Energy efficiency retrofits Renewables incl. biofuels Biofuels supply infrastructure Business model innovation Electrification/district heating
Industry & commercial 14.6%, 8.97Mt	83–87% Emissions are highly decarbonised by 2050 but significant residual	Irish TIMES: 97% possible by 2050	Electrification (Irish TIMES) Renewable energy, incl. Biomass (Irish TIMES, SEAI) Carbon capture and storage (CCS) (Irish TIMES) Efficiencies	Use of biofuels at scale Innovative materials technology
Transport 18.9%, 11.61Mt	54–67% Significantly decarbonised by 2050 but high level of residual	Irish TIMES: 93% possible by 2050 National target 10% electric vehicles in fleet by 2020	Biofuels (Irish TIMES; 80% of transport energy) Reduced transport energy demand (Irish TIMES) Electric vehicles (Irish TIMES)	Biofuels Travel demand measures Improved electric vehicle technology and affordability
Agriculture 30.5%, 18.68Mt	42–49% Measures in Ireland for this not yet identified	Analysis has not been provided to 2050. Current technologies suggest reduction of 10% by 2020	Improved production efficiency (Teagasc) Nitrification inhibitors (Teagasc)	Measures for significant methane reductions, esp. biogenic. Evidence for soil carbon sink
Waste 1.4%, 0.89Mt	70–78%	Not yet modelled to 2050	Resource efficiency Recycling Methane capture	Resource management Life-cycle planning Replacement materials

\* <http://www.esb.ie/electric-cars/environment-electric-cars/environmental-strategy.jsp>

term could offer the potential for negative emissions if combined with CCS. Coordination between the energy and forestry sectors, and also with planning guidance for heating systems would be important. Sweden is a good example: there, in 2006, biomass provided 62% of the fuel for district heating.<sup>15</sup> There may also be a greater market for harvested wood products through sustainable design, for example timber-framed housing, bio-degradable packaging and materials, etc. Such uses may be accounted for in future reporting of GHG emissions.

Developments in the Kyoto Protocol since 2010 have led to some reform of the rules related to the accounting of emissions and sinks associated with forest land management. These revised rules enable more appropriate reporting of carbon emissions and sinks directly associated with human impacts on the system, and make provision for the treatment of natural disturbance and additional measures to improve carbon uptake within managed forest land. The assessment in this report (Table 2.2) is based mainly on the potential for carbon uptake within lands afforested since 1900, as reported under Art. 3.3 of the Kyoto Protocol. The additional potential of Art 3.4 Forest Land management accountable under the revised accounting rules is not considered here.

#### 2.4.5 Transport

Transport has been Ireland's fastest growing sector: emissions have more than doubled since 1990 (an increase of 126% to 2010). For the future, a suite of options from national to local levels is required. These strategies must be linked and aligned with efforts in planning to rationalise demand for transport of all types. Brown et al. (2011) suggest that the following elements needed to be considered:

- Modal shifts towards public transport;
- Fuel switch encompassing biofuels, electric vehicles;
- Biofuels particularly for larger, haulage and passenger vehicles;

- Road pricing combined with ICT<sup>16</sup> for traffic planning;
- Car sharing and car rental availability.

Transport technology is not seen as within the control of Irish authorities because Ireland has been a technology importer with fuel-efficiency improvements driven in the EU by voluntary industry standards. However, the graduated vehicle registrations tax with tax bands based on emission performance has contributed to reduced fuel usage through changed vehicle purchase behaviour. National policy can have a significant influence on the deployment of advanced low-carbon technologies. The national target for electric vehicles is one step forward in this direction. 'Green Bus Fund' schemes such as those introduced in the UK can increase deployment of low-carbon public transport vehicles (DfT, 2012). The Green Bus Fund supports bus companies and local authorities in England to help them buy new low-carbon buses. Its main purpose is to support and hasten the introduction of hundreds of low-carbon buses across England. Compressed natural gas and hybrid buses are some of the technologies supported. The Irish TIMES analysis indicates that biofuels will be a key component for the transport sector to 2050 and contribute just over 80% of transport energy (Ó Gallachóir et al., 2012). National policies and planning will be required to advance this. Electric vehicles are discussed further in Section 3.3. Hydrogen vehicles are not yet sufficiently close to commercialisation to assess their potential role in Irish transport.

An overall decrease in transport energy demand is also needed. To date, national and local bike schemes have proven popular and show the potential of alternative transport solutions. Assessment of these is required, i.e., whether users have switched from walking, public transport or from private transport. Land-use and transport infrastructure planning is also a key component of travel-demand management, locating residential areas close to amenities and employment. Public transport infrastructure requires investment at national and local levels with the same enthusiasm as road network improvements. Solutions such as Bus Rapid Transit (BRT) have the capacity to

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15 [http://www.iea.org/textbase/nppdf/free/2007/Renewable\\_Heating\\_Cooling\\_Final\\_WEB.pdf](http://www.iea.org/textbase/nppdf/free/2007/Renewable_Heating_Cooling_Final_WEB.pdf)

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16 Information and communication technology.

replicate fixed rail service levels by enhancing priority bus corridors with lower investment costs.<sup>17</sup>

#### **2.4.6 Heat**

There is considerable scope for improving efficiency in the heating sector for both business and domestic users. The Irish TIMES model suggest that, to achieve an 80% cut in total emissions across all energy sectors, energy consumption for heat should reduce significantly.

There is no single solution to reducing emissions in this sector. Efficiency and retrofits, fuel switch (including biofuels and electricity as well as renewables) all play a role. If biomass is to play a role, distribution systems would need to be considered. District heating fuelled by biomass could be the most commercial approach. Infrastructural planning coordinated with regional or local planning would be required for the deployment of district heating. Strategies for the use of biomass, including planning for logistics of distribution and projections of cost, should be coordinated with strategies for the production of biomass and biofuel feedstock in the agriculture and forestry sectors.

The Irish TIMES model projection suggested that, in 2050, use of coal and peat is negligible regardless of emission-reduction targets. It is clear that perverse incentives for the use of solid fuels, such as the exemption of coal and peat from the carbon tax, act as a barrier not only to ambitious mitigation action but more generally to efficient evolution of the heat service industry.

#### **2.4.7 Waste and Resource Use**

Waste management is being addressed under a range of EU and national policy agendas. These are largely climate positive: for example, reducing fugitive gas emissions from waste has important co-benefits, particularly in the context of the EU Landfill Directive (99/31/EC). The waste hierarchy of reduce, re-use, recycle is also pertinent to saving emissions. Consideration of the life-cycle of production

and consumption and the embedded emissions of products and services is important for global emissions reductions.<sup>18</sup> Sustainable production and consumption are a growing consideration in international markets. Production standards should prevent the use of non-recyclable or non-biodegradable raw materials in low-value consumables. Limits to waste generation will drive design and manufacturing efficiencies. However, such products need to appeal to the mass market to be effective in reducing emissions. The perception that a low-carbon/waste society equals low quality of life has to be avoided. Cutting-edge low-carbon/waste technology with high design quality will reverse this sentiment.

Life-cycle analysis (LCA) will influence decision-making and low-carbon lifestyle choices in future markets. New business models based on renting, sharing, and swapping can reduce global emissions by preventing the inefficient consumption of goods. Services including matching, customising and the maintenance of products can also contribute in this area.

Energy is being produced from waste and further development of this potential may be possible through incineration, anaerobic digestion or more advanced technologies, for example advanced bio-refinery. This requires planning and integration of energy and waste policy areas.

## **2.5 Ireland in 2050**

[Figure 2.2a](#) shows a potential scenario for Ireland using EPA data (up to 2020), results from the Irish TIMES energy modelling project, as well as application of assumptions from the EU 2050 Roadmap to the waste and agricultural sectors. A comparative figure for the EU was shown in [Fig. 1.1](#), Section 1. The emissions profile for Ireland from 1990–2010 is markedly different to that for the EU shown in Section 1.

The large share of agriculture is also unique in the EU. The 2050 emissions profile, as shown in [Fig. 2.2b](#), reflects the fact that current mitigation options for the agriculture sector are limited. Though a 49% reduction in agricultural emissions by 2050 has been assumed, following the EU analysis, measures have not yet been

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17 Bus Rapid Transit systems use conventional bus vehicles but replicate the advantages of mass transit rail and light-rail systems by completely separating bus lanes from other traffic, giving priority through junctions, improving passenger facilities and ticketing at stops and importantly improving the frequency of services including through use of on-board ICT systems for drivers.

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18 Embedded emissions are those emissions released in the production of the good, including processing emissions, emissions from the production of inputs, associated direct and indirect land-use change etc.

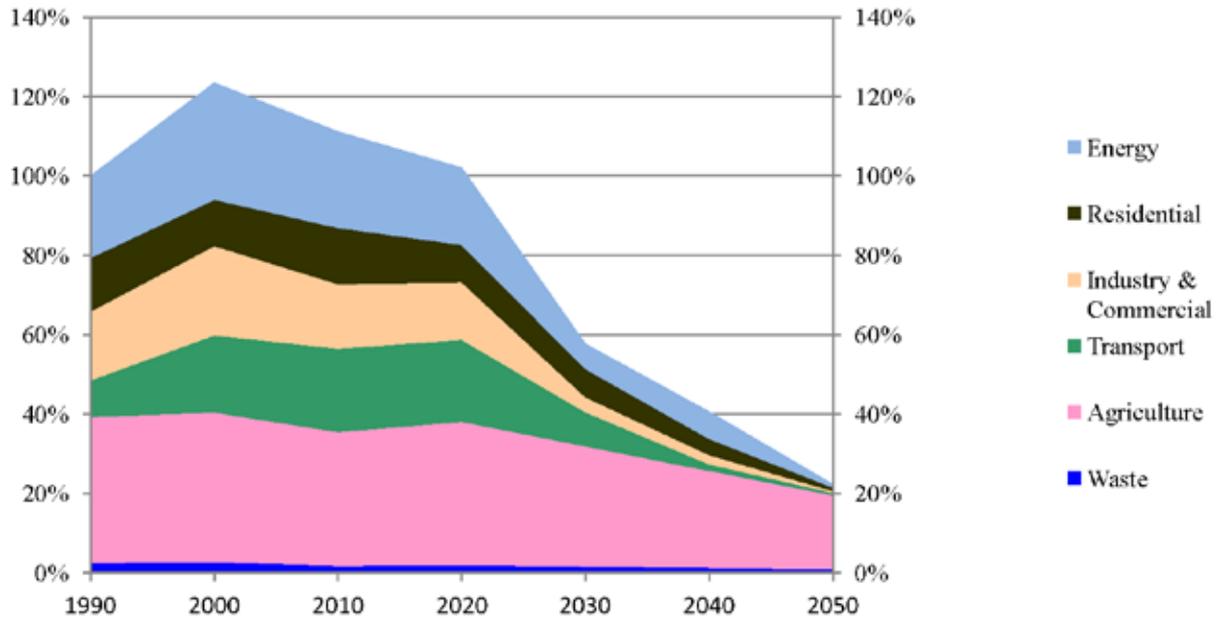


Figure 2.2a. Potential emissions in Ireland 1990–2050 (EPA, 2011, 2012; EC, 2011; Ó Gallachóir et al., 2012).

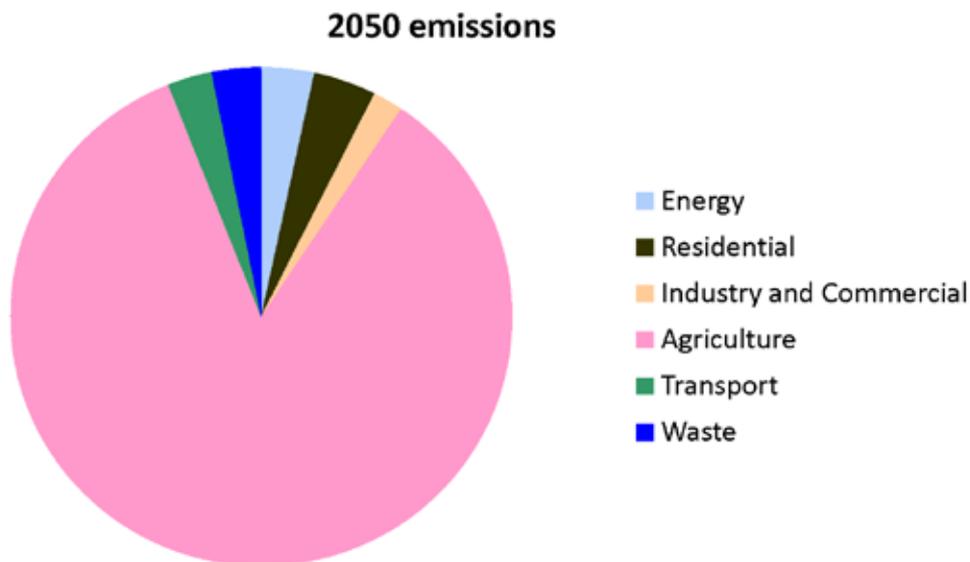


Figure 2.2b. Potential sectoral shares of emissions in Ireland in 2050 with approx. 80% cut on 1990 emissions (EPA, 2011, 2012; EC, 2011; Ó Gallachóir et al., 2012).

identified in Ireland to achieve this level of mitigation without a reduction in farming activity.

Considerable global research effort in this area is under way and more investment in research in this area is required. However, this limited emission reduction by agriculture, in the context of an 80% national target, would place an extra burden on other sectors. In order to approach a reduction of 80% in Ireland comparative to

the EU effort, the energy sector (including transport, heat) must reduce emissions by 95% in order to compensate for the limitations in agriculture. Despite ambitious cuts in the energy sectors, the scenario illustrated in [Fig. 2.2a](#) still achieves only a 78% reduction in emissions from 1990 levels. If there were a commitment to meet an 80% emission reduction by 2050, offset purchases or forestry sinks up to 1.1MtCO<sub>2</sub>e would still be required.

## 2.6 A Greenhouse Gas-neutral Ireland

The GHG-neutral approach would not require all activities or sectors to achieve a GHG-neutral status. Rather, emissions associated with one activity could be offset by a carbon sink or by robust offset mechanisms. The more GHG efficient the activity, the less the need for offsetting. The scenario presented in [Fig. 2.2a](#) suggests residual emissions in 2050 of 12.14MtCO<sub>2</sub>e. Further options would therefore be necessary to move towards a GHG-neutral Ireland by 2050. Primarily, the inclusion of sinks in forestry and other land-use sectors would be required.

A first analysis of potential land use and associated emissions and sinks for 2050 are provided in [Table 2.2](#). These suggest that sinks could offset up to 8.9MtCO<sub>2</sub>e. Any further gaps would need to be met by international purchases of carbon offsets or other new market mechanisms.

To achieve targets without international purchases could be very costly and would most likely require a step-up in ambition from the agricultural sector, or negative emission measures such as CCS with biomass. Nevertheless, this indicative analysis shows that, while highly ambitious, a GHG-neutral Ireland would be feasible in the context of continued efforts to stay on track to the 2°C goal.

This analysis has not included an assessment of the costs of achieving GHG neutrality in Ireland. Estimates of investment costs in the energy sector are available in Ó Gallachóir et al. (2012). There are no estimates available for the costs in 2050 Ireland of other activities, particularly agriculture and land use. It is important to bear in mind that transformational change is harder to cost than marginal change as the costs may be to some extent endogenous to the transformation – for example, economies of scale may be achieved in technologies that become widely used in a transformative scenario, while learning-by-doing effects can also act to reduce costs. The analysis of costs across sectors would be an important area for future research.

## 2.7 Conclusions

Meeting the 2020 GHG emissions targets under the EU CEP will be challenging but must be recognised as being an important step in moving to a yet to be agreed sustainable emissions profile by 2050.

The EU 2050 Roadmap provides a useful template for the analysis of long-term GHG emissions pathways in Ireland. The analysis presented here suggests that, with current technologies, cross-sectoral emissions reductions of up to 80% are possible with the other sectors making up for limitations in agriculture. This would require effective decarbonisation of energy production, transport and space heating. This is required if emissions from agriculture are to be maintained at a level that is potentially consistent with current or 'Food Harvest 2020' production levels.<sup>19</sup>

A wider carbon neutrality approach, which includes estimates of sink potentials, suggest that GHG neutrality by 2050 is possible for Ireland. This is based on the achievement of major emissions reductions and the enhancement of a range of sinks. Use of international offsets would also be possible in such an approach.

This preliminary assessment requires development and refinement but provides a useful analytical framework for linking a range of analyses, consideration or policy and informing research effort. A concerted approach to the identification of new mitigation possibilities, including targeted research, development and deployment and a dynamic policy dialogue at national EU and UN levels are required.

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<sup>19</sup> The Food Harvest 2020 report was developed by Dept. of Agriculture as a cohesive roadmap for the industry to build capacity, adapt to challenge and grow in the context of emerging opportunities. Targets include the growth in value of primary output by €1.5bn, value added inputs by €3bn by 2020 and a target of 42% growth in exports from 2007–2009 to 2020 (DAMF, 2010).

Table 2.2. Land-use emissions and sinks in Ireland.

Land type	Land cover area		Current sink/source estimate	Management option	2050
	Ha	%			
Improved grazing land management; Mineral soils	3.4Mha	43	10.8MtCO <sub>2</sub>	Maintain or enhance sink through active management. 1–2t C /ha* per year	*10.8MtCO <sub>2</sub>
Rough grazing land management; Mineral soils	0.3Mha	4	Carbon neutral	Improved protection of vulnerable areas Enhanced sink management 30% of area, with 0.5tC/ha removal	0.16MtCO <sub>2</sub>
Grazing land management; Organic soils	0.3Mha	4	-2.2MtCO <sub>2</sub>	2–3tC/ha per year emission Active water table management, avoiding CH <sub>4</sub> emissions. 50% reduction in emissions	-1.1–MtCO <sub>2</sub>
<b>Total grazing land<sup>(1)</sup></b>	<b>4.0Mha</b>	<b>51</b>	<b>8.6MtCO<sub>2</sub></b>		<b>9.9–MtCO<sub>2</sub></b>
Cropland	0.35Mha	5	Carbon neutral	Reduced tillage, No tillage. Widespread adoption of cover crops. Establish sink of 0.25tC/ha on 250kha cropland. The steady decline in cropland area to continue.	0.23–MtCO <sub>2</sub>
<b>Total cropland</b>					<b>0.23 MtCO<sub>2</sub></b>
Peat/wetland; Unmanaged intact	0.12Mha	2	GHG neutral	CH <sub>4</sub> emissions offset by carbon sink. Maintain carbon stock	
Peat/wetland; Unmanaged degraded	0.70Mha	10	-5.2MtCO <sub>2</sub>	Source of CO <sub>2</sub> emissions 2–4tC/ha Rewetting and active water table management. 30–60% of degraded peatland restored to ecosystem function. Carbon neutral. A 1.6 MtCO <sub>2</sub> emission reduction.	-3.6 MtCO <sub>2</sub>
Peat/wetland; Managed (extraction)	0.08Mha	1	- 0.6MtCO <sub>2</sub>	Source of CO <sub>2</sub> emissions 2–4tC/ha. Rewetting and active water table management. 60% of degraded peatland restored to ecosystem function. Carbon neutral. A 0.36MtCO <sub>2</sub> emissions reduction.	-0.24 MtCO <sub>2</sub>
<b>Total peat/wetland</b>	<b>0.9Mha</b>	<b>13</b>	<b>-5.8MtCO<sub>2</sub></b>		<b>-3.9 MtCO<sub>2</sub></b>
Forest				Afforestation programme 17% coverage.	
Since 1990	0.28Mha	4	2.8MtCO <sub>2</sub>	Afforestation at 15kha p.a. 12% coverage. Sustain current removal rate.	2.8 MtCO <sub>2</sub>
Pre-1990	0.38Mha	5	0.71MtCO <sub>2</sub>	Maintain cover, carbon neutral. Becomes a source ca. 2020, moves to neutral towards 2050.	0.0
<b>Total forest</b>	<b>0.66Mha</b>	<b>9</b>	<b>3.51MtCO<sub>2</sub></b>		<b>2.8 MtCO<sub>2</sub></b>
<b>Total</b>	<b>7.1Mha</b>	<b>100</b>	<b>6.3MtCO<sub>2</sub> p.a.</b>		<b>8.9 MtCO<sub>2</sub></b>

\* Note that Table 2.2 illustrates sinks as a positive number and sources as a negative.

<sup>(1)</sup> Byrne K.A., Kiely G., Leahy P. (2007)

## 3 Policies and Market Mechanisms

The availability of options to reduce emissions and a global awareness of the mitigation requirements do not in themselves lead to adequate global action. Government intervention, including various policies and enabling market mechanisms, are crucial to kickstart and sustain necessary action. This section considers options to instigate required action. These include legal instruments, the market or other approaches. The key EU and UNFCCC policy instruments are considered along with the interactions between them. These include:

- The ETS and non-ETS sectors and interactions between these;
- The Kyoto Protocol market mechanisms: Emissions Trading, the Clean Development Mechanism (CDM), and Joint Implementation (JI) and the development and refinement of these for the second Kyoto Protocol commitment period;
- A proposed new market mechanism for the post-2020 global regime.

A range of options for Ireland to use these approaches to reach 2020 non-ETS and 2050 economy-wide targets is explored. Logically, there are three categories of possible strategies for Ireland:

- 1 Achieve domestic emissions reduction through policies and market approaches;
- 2 Achieve compliance through market mechanisms;
- 3 Move non-ETS emissions into the ETS sector.

This section explores these strategies and relevant carbon market issues, including the potential for a new market mechanism under the UNFCCC.

### 3.1 European Union Emissions Trading Scheme

The EU ETS covers approximately 11,000 installations, 50% of CO<sub>2</sub> emissions and 40% of the GHG emissions of the EU. Participants are large installations in the power and heat generation industry and in selected energy-intensive industrial sectors. The ETS is a 'cap and trade' system, limiting the amount of emissions allowed in a

given period, issuing *ex ante* a corresponding amount of allowances to installations, requiring the surrender of allowances to match actual emissions, and then creating a system for trade in units of those emission allowances to reduce costs in meeting targets.

The current phase of the ETS ends in 2013 in line with the first commitment period of the Kyoto Protocol. Under this scheme each Member State created a national allocation plan for the free allocation or auctioning of allowances and the set-aside of allowances for new entrants. Ambition was to some extent at the discretion of the Member State, but with reviews of national allocation plans by the EC.

The aggregate of each Member State's national allocation plans or caps gave the total EU cap on emission. By allowing free trade in allowances (EUAs), the ETS incentivises mitigation activity where it is cheapest, and equalises the marginal cost of emission reduction across the covered industries.

From 2013 onwards a single EU cap will be applied (an annual 1.74% reduction or 21% reduction on 2005 levels by 2020) to covered installations. The international aviation sector will also be included (see [Box 3.1](#)). The allocation plan has been agreed at EU level. The plan includes a gradual move towards full auctioning of allowances by 2027, except in cases where sectors are judged to be vulnerable to international competition, such as steel.

Installations within the ETS may also use a certain level of international credits or offsets from the UN Kyoto Protocol system to cover their emissions. Two types are allowed: (i) the CDM and JI. Both are project-based mechanisms under the Kyoto Protocol and produce offset units, certified emission reductions (CERs) and emission reduction units (ERUs) respectively (see [Box 3.2](#)). Under the current EU 20% scenario, ETS companies would be able to use already existing and pre-2013 registered CERs and ERUs. Post-2012 CERs from projects in Least Developed Countries (LDCs) may be used without limitation. Between 2008 and 2020, the EU ETS legislation provides for use of credits up to

50% of the overall reductions below 2005 levels made under the EU ETS. The exact amount per operator is to be determined in line with methodology outlined in Directive 2009/29/EC, Article 11a (8) (European Council, 2009).

### 3.1. Aviation in the EU Emissions Trading Scheme

As air travel becomes cheaper, EU emissions from aviation are increasing fast. Someone flying from London to New York and back generates roughly the same level of emissions as the average person in the EU does by heating their home for a whole year. In order to mitigate the climate impacts of aviation, the EU imposed a cap on CO<sub>2</sub> emissions from all international flights – from or to anywhere in the world – that arrive at or depart from an EU airport.

From the start of 2012, emissions from all domestic and international flights that arrive at or depart from an EU airport are covered by the EU ETS. In addition to the 27 EU Member States, the EU ETS for aviation covers three EEA-EFTA States (Iceland, Liechtenstein and Norway) and will extend to Croatia by 1 January 2014 due to the country's planned accession to the EU on 1 July 2013. It will thus soon cover 31 countries.

The intention is for the EU ETS to serve as a model for other countries considering similar national or regional schemes, and to link these to the EU scheme over time. Therefore, the EU ETS can form the basis for wider, global action.

EC (2012a)

In the context of a global agreement on climate change (i.e. a scenario where the EU steps up to a 30% commitment), only credits from projects by signatory parties may be used to reach up to 50% of the additional reductions required for compliance in the third phase of the ETS from 2013.

### 3.2. The Kyoto Mechanisms

The Kyoto Protocol introduced three trading mechanisms to assist compliance with targets. Parties with commitments under the Kyoto Protocol have accepted targets for limiting or reducing emissions. These targets are expressed as levels of allowed emissions, or '**assigned amounts**,' over the 2008–2012 commitment period. The allowed emissions are divided into 'assigned amount units' (AAUs).

**Emissions trading**, as set out in Art. 17 of the Kyoto Protocol, allows countries that have emission units to spare – emissions permitted them but not 'used' – to sell this excess capacity to countries that are over their targets.

The **Clean Development Mechanism** (CDM), defined in Art. 12 of the Protocol, allows a country with an emission reduction or limitation commitment under the Kyoto Protocol to implement an emission-reduction project in least developing countries (LDCs). Such projects can earn saleable certified emission reduction (CER) credits, each equivalent to one tonne of CO<sub>2</sub>, which can be bought by developed countries and counted towards meeting Kyoto targets.

The mechanism known as '**joint implementation**' (JI), defined in Art. 6 of the Kyoto Protocol, allows a country with an emission reduction or limitation commitment under the Kyoto Protocol to earn emission reduction units (ERUs) from an emission-reduction or emission removal project in another committed Party, each equivalent to one tonne of CO<sub>2</sub>, which can be counted towards meeting its Kyoto target. ERUs are thus converted AAUs from the country which hosted the project.

UNFCCC (2012)

## **3.2 European Union Emissions Trading Scheme and the 2 Degrees Goal**

The analysis provided in Section 1 based on the AR4 and from the European Climate Foundation suggests that early action is required in order to stay on track to the 2°C goal. This imperative is particularly keen in the energy and industrial sectors where long-life assets are prevalent. The EU Commission's 2050 Roadmap, as well as Irish analysis (Ó Gallachóir et al., 2012), show that these are also the sectors expected to almost completely decarbonise by 2050. Immediate incentives and long-term price signals are required to facilitate investment now in low-carbon infrastructure and assets to avoid 'lock-in' of high-carbon energy systems.

Large installations in the energy and industrial sectors are mostly covered by the EU ETS. They are collectively subject to a requirement to reduce emissions by 1.74% annually to achieve a total 21% emissions reduction on 2005 levels by 2020. Banking and carryover of allowances as well as access to international market mechanisms offer installations increased flexibility in compliance.

The targets were agreed in 2007 and legislated for in 2008. However, verified emissions in the EU ETS showed a decrease of more than 10% in 2009, compared to 2008, due to the impacts of the economic crisis (EC, 2012b). The EC's impact assessment of the CEP suggested that it implied a carbon price of approximately €30/t (EC, 2008). However, since September 2011, prices have decreased to levels below €10/t. Analysis in 2012 by the EC suggests a surplus of 1.4bn allowances may be carried forward into the 2013–2020 commitment period (EC, 2012b).

This provides a new perspective on the EU ETS ambition level and its effectiveness in providing the incentives required for low-carbon investment. Given the low-carbon price and the already existing surplus in allowances, there is currently little incentive for installations to invest in low-carbon technologies as opposed to conventional fossil fuel options with consequent lock-in effects. This risks significant increases in emissions when EU economies return to long run average economic growth rates.

The ambition level within the EU ETS and its consequent price signal also have impacts internationally. The price of CERs, produced from developing country mitigation

projects, follows (with high positive correlation) the EU ETS carbon price. A weak EU market reduces the incentive for investment in mitigation in developing countries. This affects the ability of developing countries to make the required deviation from their BAU growth in emissions consistent with the 2°C goal.

### **3.2.1 Intervention in the ETS Sector**

An emissions trading instrument is primarily designed to control the quantity of emissions, not to set a carbon price. Thus, if the cap represents an appropriate level of ambition in emissions reduction, a low price of carbon is positive as it indicates that goals are being achieved at a low cost. However, if insufficient mitigation activity is occurring, it is the result of setting an unambitious cap. High carbon prices can also be a concern but, in the current market context, the focus is on the issue of low-carbon prices.

Compliance under the ETS is the responsibility of installations. Thus, there is no immediate motive for governments to intervene on emissions in those sectors. As installations under the ETS are responsible for their compliance, government interventions are likely to be for other purposes, for example energy security, technology support, enabling enterprise opportunities or adjusting the ambition level.

The renewable energy targets under the EU's CEP are an example of a policy intervention outside the rules and procedures of the ETS which have resulted in lowering the price of carbon. Generally, supports or subsidies for low-carbon technologies act to lower the price of carbon.

A higher carbon price would encourage an earlier structural shift towards a low-carbon economy. The current low price of carbon may be a barrier to this shift. This could be addressed via a range of EC interventions (requiring initial agreement by the European Council):

- Withholding allowances from auction or;
- Acting like a central bank in the market to buy surplus allowances to maintain the price or;
- Introducing a price-floor.

The EC July 2012 draft proposal to amend the ETS Directive aims to change the auctioning schedule to defer the auction of a portion of allowances (EC,

2012).<sup>20</sup> However, without changing the overall number of allowances available within the 2020 period, there is little impact on the medium- to long-term carbon price.

The current ETS cap is part of the lower 20% overall EU emissions target. The original CEP anticipated a global agreement under the UNFCCC, leading to a step-up in EU ambition to 30% and did not anticipate the financial crisis. While still waiting on a global agreement, it would make sense to make the EU ETS cap more stringent to avoid high carbon lock-in. Cancelling allowances (e.g. those which may be withheld for later auction) is the simplest intervention to raise the carbon price and to achieve a timely transformation to low-carbon industry.

The auction of EU ETS allowances for the 2013–2020 period is expected to raise significant revenue to be channelled back to Member States. With current targets, the EC estimates approximately €21bn could be achieved. If the 30% ETS target was imposed by a reduction in the allowances for auction, the analysis suggests that the rise in carbon price would more than compensate for the lower quantity and lead to total revenues of €28bn. This increase in revenue could be a great boon to some Member States and offers a further rationale for re-considering the ambition level within the EU ETS.

### 3.2.2 *Implications for Ireland*

The EPA emissions projections suggest that Irish ETS participants could be well placed to cope with an EU step-up in ambition. Under current 20% scenarios and projected carbon prices, they exceed the average requirement with a 25% reduction by 2020. One large participant in Ireland, the ESB, already has a goal of carbon neutrality by 2035. Moreover, as noted above, revenues from the auctioning of allowances will be returned to Member States and would increase with a step-up in ambition.

Given a favourable industrial climate for increased ambition in the Irish ETS sector, and significant financial benefits for government, it suggests that the

Irish position should be to support a step-up of ambition within the EU ETS.

## 3.3 **Non-Emissions Trading Scheme**

Sectors outside of the EU ETS are diverse and are therefore subject to a range of policy instruments. As outlined at the beginning of the section, there are three categories of strategy possible to address non-ETS emissions:

- 1 Achieve domestic emissions reduction through policies and market approaches;
- 2 Achieve compliance through market mechanisms;
- 3 Move non-ETS emissions into the ETS sector.

### 3.3.1 *Domestic emissions reduction through policies and market approaches*

The Sustainable Energy Authority Ireland (SEAI), *Ireland's Low-carbon Opportunity* report shows that technical measures in the non-ETS sectors with a GHG marginal abatement cost (MAC) of up to €80/tCO<sub>2</sub>e would achieve 24% reduction on 2005 levels by 2030 (SEI, 2009b). The analysis found that Ireland had proportionately fewer abatement opportunities in the non-ETS sector than in the ETS. Though many of the measures identified are negative cost, it is clear that other unaccounted for costs and barriers exist to discourage their uptake. Even with a price on carbon, there are many barriers to behaviour change that would have to be addressed (Stern, 2007). Actual abatement may be difficult to achieve due to capital constraints, mismatched incentives and individual habits or preferences. This is particularly obvious in the heating sector, where negative cost measures to reduce emissions exist but have not been undertaken (SEI, 2009b).

#### 3.3.1.1 *Domestic policy approaches*

Economic instruments, technology, behaviour change and green procurement offer different ways of approaching emission reduction. Economic instruments such as emissions trading and emission taxes can be very effective in reducing emissions at the lowest cost by allowing the market to determine where and how to make emission cuts. Emissions trading provides more certainty on the level of emissions reductions but is not always practical or efficient to implement, particularly where emissions are distributed amongst many actors.

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20 (EC, 2012b) Decision of the European Parliament and of the Council amending Directive 2003/87/EC clarifying provisions on the timing of auctions of greenhouse gas allowances; (provisional as at 25/07/12); [http://ec.europa.eu/clima/policies/ets/auctioning/third/docs/proposal\\_for\\_decision\\_20120724\\_en.pdf](http://ec.europa.eu/clima/policies/ets/auctioning/third/docs/proposal_for_decision_20120724_en.pdf)

Taxing emissions provides less certainty on emission reductions and can be particularly ineffective where the price elasticity of demand<sup>21</sup> is low due to barriers, for example ingrained habits or lack of substitutes. For this reason, additional measures are frequently required to achieve significant reductions. Even so, taxes have the advantage of providing a double dividend, i.e. while the tax penalises and thus discourages the undesired behaviour, it also raises revenue for government. This allows government to reduce taxes on 'good' activities such as employment or sustainable profit-making or, in difficult economic circumstances, helps reduce the need for tax increases.

Where economic instruments are insufficiently effective or efficient due to the presence of barriers, other policies and measures can play an important role. These include:

- Technology policies such as support for research, development and demonstration which bring forward new technological solutions for mitigation;
- Standards and labelling such as in construction and on household appliances;
- Best available technology guidance, for encouraging the mass deployment of low-carbon technologies.

Measures to bring about behaviour change such as education and awareness-raising, carbon-management tools, peer comparisons, and subsidies can help consumers break habits and make the initial personal investment in a low-carbon lifestyle. Use of high design standards in low-carbon technologies is important to ensure that low-carbon technologies are desirable, durable and actually used effectively once purchased.

Green procurement can be used as a technology policy, a tool for behavioural change or an advance market commitment (discussed in Section 4.4). It can be used across a range of goods and services to achieve a number of aims:

- Achieving mitigation for the government sector directly;

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21 Price elasticity of demand is a measure of consumers' responsiveness to changes in price. Low elasticity means that consumers are unresponsive (i.e. they do not tend to change the level of consumption) with a change in price and vice versa.

- Supporting low-carbon businesses by opening up a large market for their products and services;
- Helping low-carbon businesses to achieve scale, thus allowing expansion of low-carbon business, bringing low-carbon products and services to the wider economy;
- Encouraging further innovation in low-carbon technology by the existence of a reliable competitive market;
- Demonstration programmes, for example in schools and community/sports centres.

### *3.3.1.2 Domestic market approaches*

Carbon market approaches can be used to incentivise domestic emission reductions on a project basis. Joint implementation (JI) projects have not been carried out in Ireland. Because Ireland was anticipated to need all of its emission allocation and further purchase of units to meet the Kyoto Protocol target, there was no rationale for converting AAUs to ERUs via JI projects.<sup>22</sup> Thus, the provisions for approving and crediting JI projects in Ireland have not been created. However, the rationale for a domestic project-based mechanism that incentivises private-sector innovation on emission reduction is receiving increased attention in Europe. Domestic offsetting (DO) is an additional policy instrument for transformation to a low-carbon society. The *National Climate Change Strategy 2007–2012* (DoEHG)<sup>23</sup> stated the government would consider the use of domestic offsets in Ireland. It would consider:

- 'Whether they [DO] can achieve cost-effective emissions reductions that are verifiable, permanent and additional to those that would otherwise take place with existing measures;
- Whether they can provide ongoing incentives for emissions reductions, for example, through technological innovation;

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22 As AAUs represent 'allowed emissions', they are valuable to governments to meet international Kyoto Protocol commitments. Conversion of AAUs to ERUs is normally accompanied by a transfer to private entities and/or other states. Thus by reducing the AAUs available to the domestic government for compliance, while potentially having exploited low cost mitigation options, JI can make it more difficult for a state to meet KP commitments.

23 <http://www.environ.ie/en/Environment/Atmosphere/ClimateChange/PublicationsDocuments/FileDownload,1861.en.pdf>

- Whether such reductions could be accounted for in Ireland's national inventory of greenhouse gas emissions and thus lead to real reductions in Ireland's distance to target;
- Whether the potential benefits of the schemes would justify the administrative costs, which are likely to be significant.'

The EPA study *Domestic Offsetting, Scoping Study for Ireland*<sup>24</sup> concluded that 'a carefully designed DO [domestic offsetting] scheme could facilitate the uptake of best practice and the creation of new employment/export opportunities, and could also assist Ireland in the transition to a low-carbon society'. The study examined three approaches to domestic offsetting: (i) use of the JI mechanism, (ii) an Irish domestic ETS and (iii) government commitment to buy DO credits. The study concluded that 'a moderate investment could be warranted to further explore this approach' (EPA, 2011). Domestic offsetting could be piloted via a government tender for private-sector mitigation projects. This should be done so that projects achieve real mitigation, while reducing the administrative burden required by international schemes. Cost-effectiveness would be a key criteria in the process so that government could receive cost-effective emissions reductions which could be used towards 2020 compliance. This would embed low-carbon technologies or infrastructure which will continue to offer mitigation benefits beyond 2020. Such investment in domestic mitigation would have benefits for enterprise development and local economies in Ireland with the potential for job creation.

### 3.3.2 *Compliance in 2020 through market mechanisms*

The CEP Effort Sharing Decision (ESD) 406/2009/EC allows transfer of part of annual emission allocations between Member States, sometimes called 'statistical transfers'. It can be seen as a less formalised cap and trade scheme. It also allows limited use of internationally recognised emission units such as CERs, ERUs and possible new units which may arise out of an international agreement.

The EC estimated that under the cost-efficient reference scenario of the 20% target with no trade, the non-ETS

and ETS carbon prices would equal €39/tCO<sub>2</sub>e (more recent estimates are lower due to the fall in economic activity caused by the economic crisis). Other scenarios see significant differences between ETS and non-ETS prices (EC, 2008), with the ETS price being greater. There is potential in the Directive for non-ETS emissions reductions to be traded into the ETS, which could act as a cost-saving measure for ETS installations if ETS prices are greater. On the other hand, EU ETS allowances are not allowed for compliance under the non-ETS targets, although Tol (2009) suggests that allowing use of ETS allowances to meet non-ETS targets would reduce EU costs of mitigation in the event of unexpected difficulties in meeting non-ETS targets. In Ireland it is anticipated that the MAC in the non-ETS sector will exceed that in the ETS sector. For most EU countries, the MAC is expected to be lower than the non-ETS. As a result, it is expected that Ireland would be a potential buyer of emissions allocations from other Member States.

External trading in emissions, using CERs and ERUs, can act as a dampener on the EU ETS and non-ETS prices. However, the extent to which external trading may be used to meet non-ETS targets is limited at 3% for most EU Member States (with an additional 1% for some Member States, for example Ireland and Portugal) which must be sourced from CERs from LDCs.

The rules for the use of flexible mechanisms in an EU move to an overall 30% emission reduction objective by 2020 have not been agreed. Commission working papers consider that, in a 30% reduction scenario, 5% could be achieved through international trading and 25% through domestic action (EC, 2012b). The distribution of effort within the EU has not been agreed and thus projecting a price for either the ETS or non-ETS sectors is difficult. However, the IPCC analysis of a 450ppm CO<sub>2</sub>e stabilisation pathway which would also be consistent with a 30% target suggested that a global carbon price of up to €80/tCO<sub>2</sub>e would be required by 2030.

The use of market mechanisms to reduce the costs of compliance can be warranted. However, an approach to compliance based solely on purchasing units would not be cost effective, particularly in the long run. Low and negative cost-mitigation measures still need to be achieved in Ireland. Doing this would have additional benefits such as energy and production efficiencies.

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24 [http://www.epa.ie/downloads/pubs/research/climate/CCRP\\_6\\_web.pdf](http://www.epa.ie/downloads/pubs/research/climate/CCRP_6_web.pdf)

These should be implemented before government revenue is spent on purchasing compliance. Furthermore, purchasing compliance today means that the covered emissions in Ireland still have to be addressed in future compliance periods up to and beyond 2020. Investment in mitigation today can embed emissions reductions to the economy, thus reducing the required efforts and cost of meeting future targets. Finally, the innovative power of the private sector has not yet been brought to bear on Irish non-ETS emissions. Before spending money on international emission reductions to achieve domestic compliance, opportunity should be given to the private sector to achieve domestic mitigation with similar resources.

### **3.3.3 *Transfer of non-ETS emissions into the ETS***

The analysis has reflected the EU ETS and non-ETS policy framework. While the line between the ETS and non-ETS sectors is clear, it is a porous line that allows influence on emissions to move both ways.

The relative certainty achieved in ETS emissions can appeal to policy-makers grappling with the difficulties of non-ETS emissions. The ETS puts the onus for innovation and initiative to meet the established target onto the private sector. Management of the reductions undertaken is not required. Thus, expanding the use of the ETS could be a useful strategy for sectors where emissions are hard to regulate. The 2008 ESRI *Medium Term Review of the Irish Economy* estimated that the ETS will cause a 5MtCO<sub>2</sub> or 34% saving in power generation in 2020 (Fitzgerald et al., 2008). It projected that the EU ETS carbon price in 2020 would be €38.20/tCO<sub>2</sub>e. However, the same price applied as a tax to the non-ETS sector effects just 0.5MtCO<sub>2</sub>e or 1% savings. The Carbon Tax announced in the 2010 Irish budget was set at €15/tCO<sub>2</sub>e. Provision was made in the 2012 Finance Bill to allow for an increase to €20/tCO<sub>2</sub>e in the rate applied to mineral oil liquid fuels and gas. Given a situation where the desired mitigation targets (-20%) would not be met by imposition of a tax equal to the market price of carbon (i.e. ETS mitigation is 'easier' than non-ETS), a good strategy in theory would be to bring all sectors into an ETS, preferably a single cross-sectoral scheme.

Moving emissions into the ETS sector could be achieved in a number of ways:

- 1 Integration of small installations to cross the size threshold for ETS participation;
- 2 Inclusion of additional installations or emission types in the ETS;
- 3 Promotion of electrification in non-ETS sectors, i.e. heat and transport.

There are practical difficulties with the first option. Such intervention by the government could amount to market interference and/or distortion in competition. There are commercial and economic reasons why installations were developed to the size they are and in a dispersed fashion. Ireland is a small market and this has an effect on the size of installations in Ireland. Addressing these small installations would not make a significant impact on progress towards targets.

The second option again presents difficulties. As above, there were valid reasons for the omission of certain sectors and the setting of thresholds. Emissions outside the EU ETS currently include agriculture, transport, residential and small commercial heat and small industry. The administrative burden imposed on small business would not merit the limited benefits of their inclusion. Multiple small and dispersed actors result in increased transactions costs would limit the rationale for straightforward expansion of the ETS. Moreover, it would require renegotiation of the EU ETS at a political level.

The third option, electrification of heat and transport, may have potential and needs to be explored further. Energy-related CO<sub>2</sub> emissions in the non-ETS sectors were 6.7% above 2005 levels in 2008 and have grown by 71% between 1990 and 2008 (SEI, 2009a). Much of these energy demands could be delivered by electricity, substituting for solid or liquid fuels. Technology exists for electrical heat supply. It is already the second most popular energy supply for heating in the residential sector (SEI, 2009a). Technology for electrified private transport is emerging. The Irish government has set a target for electric vehicles to reach at least 10% of the fleet by 2020 (DCENR, 2010). The extent to which Irish transport needs can be met through electrification may ultimately be limited by the technology. Irish TIMES projections suggest that even in a highly ambitious scenario of 95% cuts in GHG emissions from energy sectors, electric vehicles would only supply

approximately 16% of transport energy demand in 2050 (Ó Gallachóir et al., 2012).

If a non-ETS emission source switches to electricity, non-ETS emissions drop. The GHG emissions do not (necessarily) disappear, but they change in profile. In the case of switching to electric vehicles, the national inventory would show a reduction in road transport emissions and an increase in emissions from electricity. The extent to which emissions increased or decreased within that transaction would depend on the emission intensity of the electricity supply and the comparative energy efficiency of the new vehicle or heater. It is worth noting that electricity in Ireland currently entails emissions of approximately twice as many gCO<sub>2</sub>/kWh as oil, i.e. twice the emissions for the same delivery of energy, though this is not based on a full life-cycle analysis (SEI, 2009a). This is relevant for spatial heat demand. The conversion of energy to movement in an electric car is more efficient. For example, a typical small car has emissions of 120gCO<sub>2</sub>/km. Consultants at Ecometrica assessed that electric vehicles (based on data from Nissan, Mitsubishi and Renault) in the UK would emit 75gCO<sub>2</sub>/km based on the emissions profile of the average electricity supply on the UK grid (Ecometrica, 2011). It is not unreasonable to predict further improvements as the technology develops and as the electricity supply decarbonises.

The GHG emissions from electricity are mostly included in the EU ETS, where the overall emissions are capped. As a result, where emissions are transferred out of the non-ETS sector into the ETS, those emissions can be seen as eliminated.

There would also be air quality co-benefits. Instead of diffuse emissions of air pollutants, which are economically and technically difficult to address, any emissions would now come from large electricity generation installations, where it is more economic to employ technologies such as 'scrubbing' to reduce emissions.<sup>25</sup> The emissions are also less likely to be generated in urban environments. Reductions in non-GHG emissions such as PM, NO<sub>x</sub> and CO, which are particularly important in urban and suburban settings, could be expected thus bringing benefit to human and environmental health.

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25 Scrubbing is a technical process to remove sulphur dioxide from exhaust flue gases of fossil-fuel power plants.

An increase in electricity demand on the island of Ireland would attract more competition with the hope for an attendant reduction in prices in the long run. Thus, electrification could have macroeconomic benefits.

In the medium to long run, direct GHG savings from electrifying heat and/or transport would improve as the GHG efficiency of electricity generation increased. The 2020 targets for the share of renewable energy in the electricity supply support this. Electricity generation shows large potential for significant decarbonisation through new and emerging technologies as discussed in Section 1.5 above. Moreover, greater demand from heat and transport for energy to be stored (storage heaters, car batteries), could increase the capability of an electricity system to handle greater proportions of intermittent energy supplies, such as wind energy.

The emission intensity of the electricity sector may also decrease with utilisation of CCS technology in the medium to long term. There is a small political risk that if demand for electricity increased sufficiently to cause a significant increase in the price of carbon, there could be political pressure for a relaxation of ETS targets, but this is unlikely with the current low levels of demand. Furthermore, the volumes involved would be large and unlikely to occur through Irish activities alone. More analysis is required on the thresholds for large impacts on the carbon price.

It should be noted that some behavioural change, in particular in the transport sector, would be required for a fuel switch towards electricity. Currently, available electric vehicles have limited driving range and long recharge times. It is unclear the extent to which these limitations will be resolved in the short to medium term.

### 3.4 New Market Mechanisms

The establishment of a new market mechanism was agreed in Durban 2011. Its modalities and procedures are to be agreed at the next Conference of the Parties (COP) in Qatar in 2012. Development of projects in LDCs and Small Island Developing States (SIDS) has been very limited thus far, and there has been a desire to reorient the CDM towards those countries. In the EU this led to the imposition of a limitation on the use of CERs within the EU ETS from 2013 to only those from SIDS and LDCs. However, by excluding other developing countries from the EU market for CERs, the

current arrangement removes the incentive for mitigation in more advanced developing countries such as China and India. It is possible that new market mechanisms in the future could again incentivise activities in these countries, but they are unlikely to be operational for a number of years. Other policies will be necessary to bridge the gap in incentives.

A new market mechanism would be a significant step forward. This mechanism should complement the CDM mechanism and operate at a wider level of sectors or sub-sectors. This would reduce the risks of carbon leakage and thus make the mitigation reductions achieved even more robust. There is potential for this mechanism to facilitate and incentivise the mainstreaming of mitigation efforts to sectoral activities and decisions in developing countries. Units from the new market mechanism might in future be allowed for compliance purposes by other countries, as well as in the EU ETS and other carbon trading schemes. As a result, it is important that the new market mechanism will have robust environmental integrity to ensure actual emission reductions at a global level are achieved.

### **3.5 Conclusions**

A range of policies and market mechanisms to reduce GHG emissions are available nationally, including taxes, standards, labelling, demonstration projects, green procurement and targeted R&D. Electrification of heat and transport could result in significant mitigation in the context of decarbonisation of power generation within the ETS. Other options available to Ireland have been established at EU and UNFCCC levels, including the EU ETS and CDM. Ireland needs to use these in an efficient manner to achieve the required decarbonisation outcomes in a cost-effective manner.

The current carbon price under the EU ETS is insufficient to promote the low-carbon shift required for the 2°C goal. To bridge the gap, ambition in the ETS sector should be increased with a tightening of the cap. This is expected to increase the carbon price and to incentivise structural shift within the energy-generation sector. Irish industry is expected to cope very well with this, while the increased carbon price would bring more revenue for government.

Market mechanisms are likely to play a role in ambitious mitigation scenarios for Ireland. However, a purchase-based compliance strategy for 2020 would be costly and would miss the potential benefits from ambitious domestic mitigation efforts, which are explored further in Section 4.

The innovative power of the private sector has not yet been brought to bear on Irish non-ETS emissions. Market approaches should be considered in the non-ETS sectors, including the development of a domestic offsetting scheme. A project approach to mitigation could have multiple benefits in permanently reducing emissions, driving innovation, informing policy and supporting the development of the green economy. Investment in such innovative approaches could be a useful alternative to expenditure on international mechanisms for compliance purchases.

Emissions reductions in the non-ETS sectors will be challenging despite the existence of low and negative cost measures, particularly in the residential sector. Nevertheless, early efforts in this sector would bring benefits, for example in energy savings, production efficiency and air quality, as well as the long-term behavioural signals to facilitate the avoidance of 'locking in' high carbon behaviours.

## 4 Economic Implications: Challenges and Opportunities

The challenge inherent in meeting the 2°C goal also represents an opportunity. The need for the mass deployment of low-carbon technologies and new GHG management and business models across the globe represents a key opportunity for economic growth, particularly for early movers. In 2011, UNEP published *Towards a Green Economy*. This report found that a green economy 'is expected to generate as much growth and employment as – or more – compared to the current "business-as-usual" scenario, and it outperforms economic projections in the medium and long term, while yielding significantly more environmental and social benefits' (UNEP, 2011). The report also finds that significant investment will be required to achieve this. The Copenhagen Accord identified the goal of mobilising US\$100bn annually to address mitigation and adaptation requirements in developing countries by 2020 and establish a fast-start finance stream.

This section explores the climate dimension in the move to a green economy in Ireland and globally. It attempts to identify ways and means that Ireland can transform to a low-carbon society at a reasonable cost and how Ireland can capitalise on opportunities brought by a global move towards a green economy.

Climate finance commitments are generally less well understood than mitigation but they also present challenges and opportunities. This section describes the nature of the climate finance commitment and presents a range of strategic considerations to optimise Irish efforts for meeting those commitments.

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. Ambitious mitigation and climate finance commitments will incur a financial cost, but, if strategically managed, could bring net economic benefit to Ireland. This section presents four approaches to reducing costs and maximising benefits as follows:

- 1 Reducing the costs of mitigation, including through identification of cost-effective options and better policy-making;
- 2 Increasing the benefits of mitigation actions by identifying synergies and ancillary benefits, such as improved air quality, increased efficiencies and energy security;
- 3 Optimising the financing of mitigation and adaptation such that the cost of capital is minimised and private sector participation is leveraged;
- 4 Increasing green economic growth driven by innovation and new enterprise opportunities at home and abroad.

Efficient use or distribution of climate finance to fund climate action in developing countries also should follow these approaches. This section begins by explaining the international climate finance context and then proceeds to elaborate arguments and methodologies for the four approaches to reducing costs outlined above. The climate finance international context becomes particularly relevant in discussion of green economy opportunities in Section 4.5.

### 4.1 International Climate Finance

Many developing countries require financial support in order to implement mitigation and adaptation measures. The EU Council in December 2009 announced a 'fast-start' financial package of 'new and additional' support for climate change response in developing countries of €7.2bn from 2010 to end-2012. The Irish share of the EU commitment was €100m over the three-year period. As a comparison, Irish government spending on official development assistance was approximately €722m in 2009 or 0.54% of Irish GDP (Irish Aid, 2010).

In addition to the fast-start finance pledges, the Copenhagen Accord and Cancún Agreements under the UNFCCC also committed up to US\$100bn new and additional support annually by 2020 mobilised by developed countries for developing countries' climate change response from public, private and innovative sources. Analysis by the UN Secretary General's High Level Advisory Group on Climate Finance (AGF), and a report for the G20 group of countries on mobilising climate finance both found that the goal of US\$100bn is challenging but feasible (World Bank, 2011). Innovative

and alternative sources of climate finance need to be explored, as well as maximising the impact and reach of traditional sources such as private finance.

Given the increase in global climate finance to 2020, it is unlikely that the Irish share of the US\$100bn would be any less than what was committed for the fast-start period, and could be up to €150m per annum by 2020. With domestic fiscal constraints, it will be challenging for Ireland to be ambitious in public financial contributions to climate action in developing countries. However, while continued efforts will be important in locating public finance for climate actions, Ireland should also explore the possibilities for mobilising private climate finance in developing countries. Such funds, if mobilised through government intervention, can count towards the US\$100bn and efforts can be reported and recognised even if they would not count towards compliance with targets for public support.

Government can use different methods to mobilise private climate finance in developing countries, for example using the Irish diplomatic network to assist Irish private-sector engagement on the ground in developing countries, offering tax incentives directed towards climate-specific private investments in developing countries, using IDA (Industrial Development Authority) and Enterprise Ireland networks to build Irish entrepreneurs' capacity for investing in climate activities in developing countries, government underwriting of investments etc. Some of these interventions could have the added benefit of supporting Irish entrepreneurship and economic activity with potential for job creation, especially when seen in the context of other Irish initiatives such as the Green IFSC.

While the Irish commitment to climate change finance will represent a cost to the Irish Exchequer, the US\$100bn commitment to support developing country climate action represents a huge new market for goods and services in developing countries.

Ireland's strong reputation on international development issues could provide a basis for advancing climate actions and solutions in developing countries. Irish-produced climate products and services that may be of interest to developing countries are discussed in Section 4.5.

The following sections explore the four approaches to optimising the Irish response to climate challenges. They also have relevance for the strategic disbursement of public financial contributions to climate response in developing countries, where cost-effectiveness is equally important for the recipient and the contributing party.

## **4.2 Reducing the Costs of Mitigation**

While economic instruments are helpful in achieving mitigation at least cost, they are not suitable for addressing all emissions and in many cases they may be insufficient for initiating change. Thus, it is necessary for policy-makers to understand emissions and mitigation opportunities to determine where government intervention might be warranted and what type of intervention would be effective.

The SEAI study, *Ireland's Low Carbon Opportunity* included the first estimate of a comprehensive GHG MAC curve for Ireland (Motherway and Walker, 2009). It shows a wide range of technical mitigation options. However, not all the measures are cumulative, while some mitigation actions might only become available at a given point in time or be dependent on other actions taking place. The possibilities and permutations can be hard to navigate, making the MAC curve an incomplete tool for policy-makers. The integrated modelling of important emitting sectors is used to gather known and assumed variables on sectoral and mitigation activities to arrive at an internally coherent and consistent estimate of an optimal pathway.

Ireland has a range of ongoing modelling activity for different sectors (see [Fig. 4.1](#)). This modelling already informs economic, energy, agricultural and forestry policy by projecting emissions or identifying low-cost mitigation options. Both centralised capacity (government and agency) and distributed capacity (university and research) are necessary in Ireland to ensure robust modelling into the future, which adapts to match a continually developing economic structure in Ireland.

Other analysis such as mitigation option analysis or MAC curves are important direct supports to decision-makers while also serving as crucial inputs to models. The *Ireland's Low Carbon Opportunity* study provided

a useful first assessment of where 'low-hanging fruit' exist in mitigation in Ireland. However, while MAC curves and statistics can illustrate and rank abatement options on the given scale, they are less effective in representing the costs and effectiveness of the various policies and measures that are necessary to deliver the illustrated technical options. Further detailed understanding of mitigation options and in particular how to ensure their implementation or deployment are necessary to support policy development.

Mandatory reporting to the EU and UNFCCC on emissions inventories and projections already provides the basis for such interaction. International review teams regularly review emissions inventories and ensure that the official data reflects the best available evidence from academic and other sources. This systematic approach could be adjusted to fit a national process for developing an evidence base for policy decisions. The key is regular feedback

between analytically well-resourced policy-makers and academia to ensure robust and transparent, evidence-based decision-making.

Competitiveness impacts to Irish business and industry of different levels of mitigation ambition under different scenarios of international action are also an important issue. Irish mitigation ambition beyond international levels might mean that in the short term Irish costs of production increase, thus affecting exports or the future attraction of foreign direct investment (FDI). Determining which Irish sectors are comparatively carbon-inefficient internationally and which are most exposed to international competition, particularly outside, the EU will be important. However, the competitiveness impacts of Irish mitigation effort are really only a concern where other countries with whom Ireland competes in exports or FDI are not required to make similar efforts. Furthermore, there may be positive impacts on competitiveness.

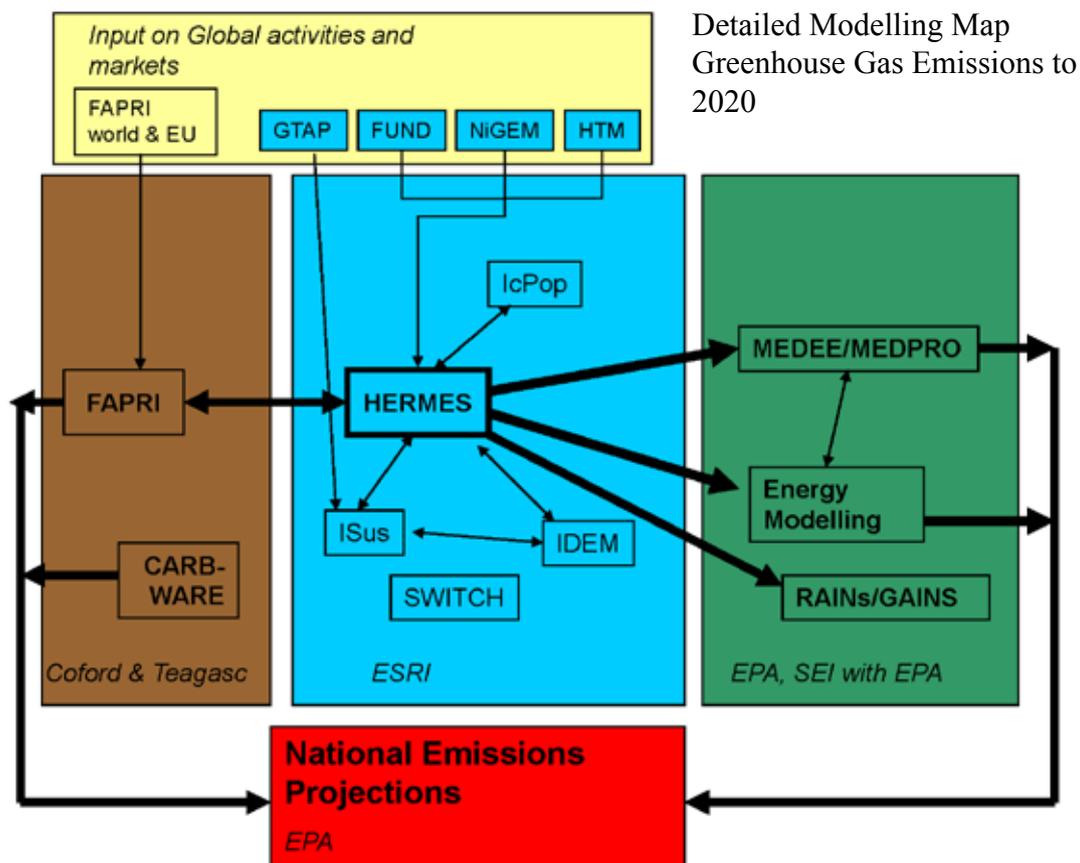


Figure 4.1. Current modelling related to national greenhouse gas (GHG) emissions projections in Ireland.

### 4.3 Increasing the Benefits of Mitigation Action

Many GHG mitigation measures have ancillary effects and/or further externalities, which offer additional incentives for their implementation. Measures with cost savings help improve Irish competitiveness and thus strengthen the Irish position as an exporting nation. [Table 4.1](#) summarises some potential ancillary effects from various mitigation measures in the key sectors.

It is important to distinguish between long-term and short-term effects. There may be costs in the short term, such as the redirection of investment and resources towards

mitigation instead of other productive uses, particularly for the individual or enterprise in question. There may also be negative effects on Irish competitiveness if Irish mitigation ambition exceeds other countries'. However, in the long term, investments will pay off in increased efficiency, lower costs of compliance and enhanced reputation for Irish products on the international market (discussed in the next section).

It is important not to neglect ancillary and wider environmental impacts when assessing mitigation measures, as these effects are usually locally experienced and can affect not only the overall costs but also the public acceptability of the measure.

**Table 4.1. A sample of potential ancillary effects from various mitigation measures.**

Sector	Potential positive externalities /ancillary benefits	Potential negative externalities /ancillary costs
Energy/power generation	Investing in renewables can reduce fossil fuel dependence, reducing imports and thus improving energy security. Potential cost savings to producers from less price fluctuations. Efficiencies in generation would also reduce costs. Air quality benefits arise from cleaner or renewable fuels.	Renewable biofuels can have transport demand implications. Biofuels can have air quality implications. Wind energy deployment needs to be coordinated with land use planning for amenity and conservation purposes.
Heat/residential	Greater efficiencies can reduce fuel poverty. Less vulnerability to price fluctuations in fossil fuels. Improved air quality. Investments in efficiency are often negative cost, more than paying for themselves within the lifetime of the dwelling place.	Use of biofuels needs to consider the sustainability of the biofuel source and transport demand implications for delivery. Initial investment costs or rises in cost of heating can impact significantly on disadvantaged communities. Domestic use of biofuels can negatively impact air quality.
Industry & commercial	Greater efficiencies reduce costs for business. Less vulnerability to price fluctuations in fossil fuels.	Use of biofuels at scale can impact transport demand. Sustainability of biofuel sources needs to be considered. Innovative materials technology.
Transport	Improved air quality. Less congestion, noise pollution.	Use of biofuels at scale can impact transport demand. Sustainability of biofuel sources needs to be considered. Changes from petrol to diesel negatively impact air quality.
Agriculture	Improved environmental quality in soil and water. Reduced fertiliser requirements and production efficiencies in animal husbandry.	Some measures which reduce N2O emissions can negatively impact water quality.
Waste	Resource efficiency reduces costs to business and consumers. Energy by-products. Less land required for landfill.	Risk in short term of sustainable products being 'engineer driven'.

#### 4.4 Optimising Financing for Mitigation and Adaptation Action

Many mitigation and adaptation measures entail a significant capital<sup>26</sup> outlay, especially where infrastructural investments are being made. For example, wind energy and smart metering entail greater capital than operating expenditure. In this context, the cost of capital is extremely pertinent and can determine the viability of a given project or investment. The cost of capital is the return to investors and is influenced by the prevalent interest rate managed by central banks and also the perceived risk of the investment. Investors may accept a low rate of return on a low-risk investment but expect a high rate of return before they will invest in a high-risk project. Projects don't only need to offer a positive return to attract investment, they need to offer a risk-return profile that is comparable with or better than other projects competing for funds. Any uncertainty in the expected return of the investment increases the cost of capital as investors demand a higher reward. The expected returns can include income from sales or the carbon market, additional savings from efficiency gains, avoided tax, and future regulatory compliance (cost savings in compliance). As a result, in the context of mitigation actions, any uncertainty about future carbon market prices, carbon taxes or regulation can increase the cost of capital.

When considering infrastructural investments, the time period over which the returns of an investment and the attendant risks are calculated is crucial. A twenty-year time-frame would be an absolute minimum over which to consider risk and returns for large capital or infrastructural projects. The policy context is crucial to climate investment costs. The EU's 2020 targets and the arrangements for the EU ETS to 2020 offer inadequate support for long-life assets. The 2050 targets agreed in the European Council would be more helpful but need to be framed in a more robust manner. International agreement under the UNFCCC could offer significant risk reduction for mitigation actions. Agreement on robust and long-term international and national mitigation targets and on carbon market rules would provide a sound basis for investment. The UNFCCC is the only forum that can achieve this goal. It is inclusive (having 195 signatory Parties); it is accepted by all

Parties as the appropriate body to discuss international climate change; it is resourced with a highly expert Secretariat; and it has the capacity to negotiate and implement an international legally binding treaty or protocol. Most likely, negotiations under the UNFCCC will not offer such certainty before 2015. Nevertheless, there are other means of reducing investment risk, particularly for private investors.

Advance market commitments (AMCs) are temporary interventions to make revenues from markets more lucrative and more certain in order to accelerate investment.<sup>27</sup> Examples include feed-in tariffs and renewables obligations, but more innovative-risk reduction policies are also available. Generally, AMCs can increase certainty by guaranteeing a minimum price for a product or by guaranteeing a market for a product (e.g. by mandating purchase or by government procurement commitments). Some instruments may guarantee a level of revenue. It should be remembered that AMCs can entail a transfer of risk or cost from the private investor to either consumers or government (there are exceptions, e.g. where the AMC addresses consumer habits that are ingrained or where it addresses private sector overestimation of risk). Therefore, intervention should be time limited and justified by reference to a specific market failure. Domestic mitigation projects or offsetting as discussed in Section 3 could act as an effective AMC in Irish non-ETS sectors.

Advance market commitments may be ineffective where other barriers to investment exist, such as a lack of suitable investment projects, or regulatory barriers. Institutional investors such as pension funds have huge resources available for investing. Where climate change can jeopardise future prosperity, the participation of institutional investors who operate over a long time horizon may be very useful. However, institutional investors usually do not have the in-house expertise to evaluate climate investments. Despite the levels of finance they have at their disposal to invest, they are constrained to minimise transaction costs. Therefore, pursuing investments in conventional projects is a more straightforward, administratively low-cost option than investing time and money in building expertise in this area. In a similar manner, to reduce transaction costs, it

26 Capital is the upfront investment cost usually for physical assets.

27 [http://www.dfid.gov.uk/r4d/PDF/Outputs/EcoDev\\_Misc/60743-Vivid\\_Econ\\_AMCs.pdf](http://www.dfid.gov.uk/r4d/PDF/Outputs/EcoDev_Misc/60743-Vivid_Econ_AMCs.pdf)

makes sense for institutional investors to pursue large-scale investments in the scale of 100s of millions. This exceeds the scale for many climate investments and thus means these projects can again be less attractive to institutional investors. These issues could be addressed by financial intermediaries who could assess, rate and bundle climate projects for sale to institutional investors. An energy service company model can be used as a vehicle to bridge the finance gap between micro climate projects at a household or SME level and the investment capacity of larger enterprises.

#### 4.5 Opportunities through the Green Economy

The challenge faced by all countries in responding to climate change creates economic opportunity for enterprise based on innovation and the efficient provision of high-quality goods and services. This has been recognised internationally and was reflected in the allocation of funds from fiscal stimulus packages to

climate change investment. Despite public commitment to play a leadership role in fighting climate change, the EU falls far behind the green stimulus of many other countries (see Fig. 4.2).

The commitment in the Cancún Agreements to provide US\$100bn per annum by 2020 for climate change action in developing countries creates a huge market for climate technologies and services. The mitigation pledges under the Cancún Agreements are helpful in indicating how developing countries may choose to spend this finance. The commitment by all countries to produce Low Emission Development Strategies (LEDS) will also be informative. To make the most of the opportunity, Irish enterprise should focus on areas of comparative advantage rather than chasing markets already captured by other players. It will be important to remember that as developing countries will be the drivers of this US\$100bn market, products and services should be designed for and directed towards their needs.

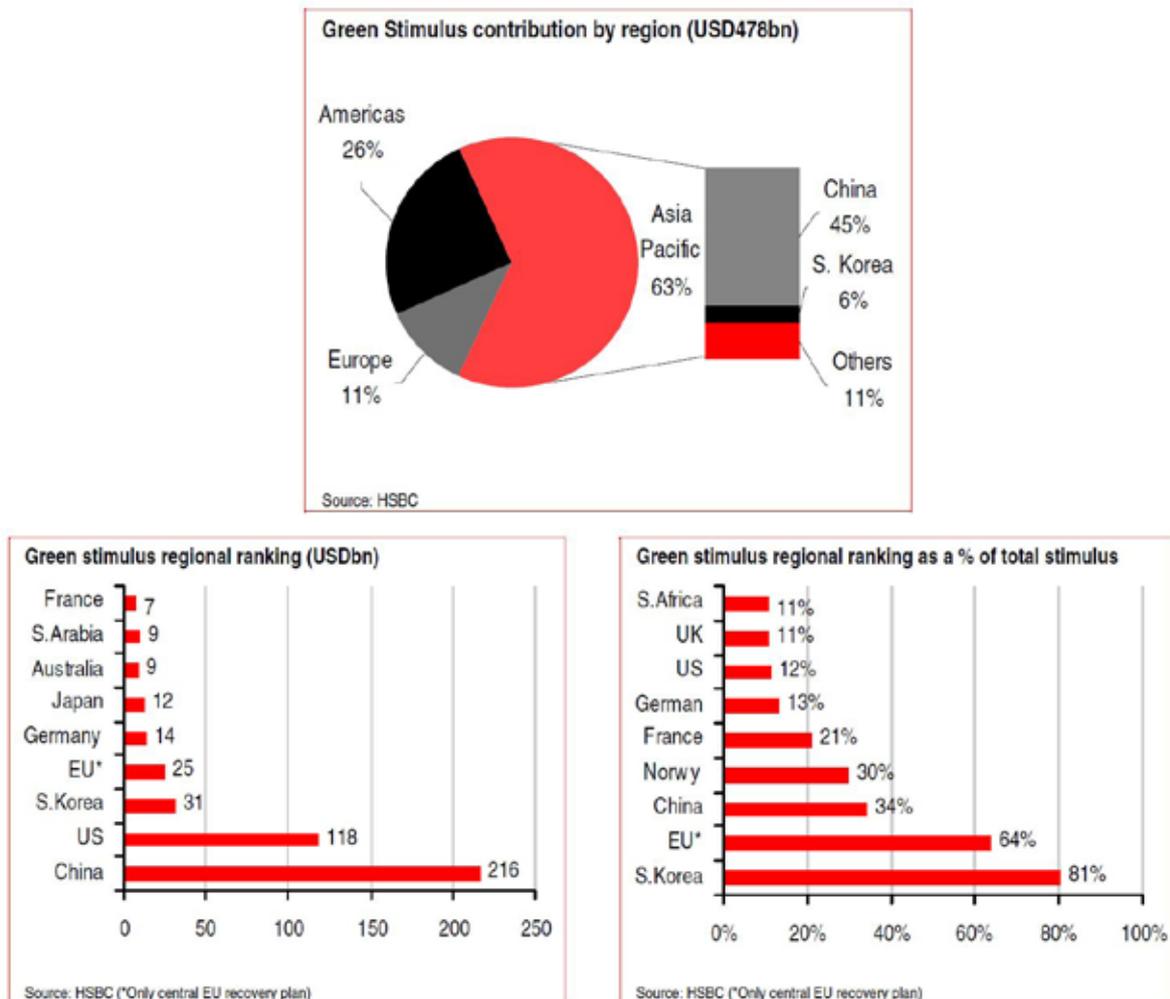


Figure 4.2. Building a green recovery (HSBC Global Research, 2009).

To capture this new and growing market, Irish climate services and products need to be visible and trustworthy. Branding Ireland as a leader in key areas of climate actions, for example agriculture and research would enhance the image of Ireland in future markets for climate expertise and sustainable goods and services. Deeper engagement in UNFCCC processes would also add to the branding effort.

There has been considerable investment in research capacity and infrastructure in Ireland through investment by the HEA, SFI and the EPA. These have resulted in advanced facilities in many third-level institutions as well as key infrastructure such as that provided by the ICHEC.<sup>28</sup> Investment under the National Development Plan (NDP) 2000–2006 led to the establishment of significant research capacity in the area of climate change. This has been led by the work of the EPA under the ERTDI 2000–2006 and, since 2007, the CCRP. The ongoing work of Met Éireann, SEAI, Teagasc and the Marine Institute are also significant contributors to this effort. Ireland's advantages of scale, geography, location and environmental quality mean that it is an excellent location to study many climate-related issues. This is evident from the international interest and investment in observations and research at the Mace Head atmospheric research station on the Galway coast, which has developed into a global leader in atmospheric research and also other locations such as Carnsore in Wexford. The institutional, infrastructural and human capacity that has been created could be used to attract international students for professional and academic courses in climate change science, management and policy. The existing capacities could also be the basis for creating an industry in climate services and professional advice. Adapting to climate change and measuring emissions will be a huge focus for developing countries. Adaptation must be informed by observations. Ireland's example as a small country developing a world-class observation system interfaced with government would be of great interest to developing countries who will not be able to operate at the scale of investment seen in other countries such as the US or Germany.

Ireland is a world leader in livestock research and is investing substantially in climate response in this area.

Agricultural emissions represent a large share of the emissions profile of developing countries. Ireland has a long history of working with developing countries. An integrated approach, linked to global climate initiatives, could bring extra opportunities for the agricultural services sector.

Ireland as an exporting nation needs to consider its brand. There is an increasing economic necessity for reporting and accounting of GHG emissions and sinks both for the carbon market but also normal producers. The importance of branding the sustainability of goods and services is already evident to many producers, particularly in the food sector. However, this needs to be built on sound science rather than assumption or statement. Green credentials are increasingly becoming a reputational issue for multinationals and global brand companies. In order to foster trust in market brands and their stated environmental credentials, these need to be informed by the rules and regulations of the emerging international climate regime and be based on robust scientific analysis.

Green credentials are also important to attracting FDI. Multinational companies seeking locations for regional headquarters or manufacturing centres will consider the green credentials likely to accrue from different locations. Access to renewable energy and to efficient green inputs and supplies will add to the benefit of a location. Progress in Irish mitigation and a movement towards GHG neutrality would act as a competitive edge both for exports of Irish goods and as well as attracting investment from international businesses.

## 4.6 Conclusions

The green economy holds significant potential for economic growth. Though the climate finance and mitigation challenges are great, informed policy supported by robust data and modelling will reduce costs while strategic planning will capitalise on key opportunities of the global transformation to a green economy.

Ireland faces significant future obligations for climate finance up to and beyond 2020 as part of the developed country commitment under the UNFCCC to mobilise US\$100bn annually by 2020 for climate action in developing countries. The US\$100bn target for climate finance represents a huge new market for climate

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28 Ireland's High Performance Computing Centre.

products and services. Irish climate finance obligations should be considered strategically for how they can enhance Irish green branding and entrepreneurial activities in developing countries. Ireland is well placed to develop markets for climate products and services in developing countries but this will need cross-departmental action to ensure that diplomatic, overseas development, research and enterprise efforts support this.

The private sector should be more engaged in climate solutions both for domestic action and for global climate finance targets. Advance market commitments and other measures to improve the attractiveness of climate action for investment should be considered. Domestic mitigation projects could be one approach to engaging the private sector in domestic mitigation. The potential for engaging institutional investors in climate action

needs to be explored. A robust carbon price and long-term policy signals are crucial to sustained private sector engagement.

Developing a low-carbon 'green' branding for Ireland would bring benefits to Irish exports and to attracting FDI. This branding exercise would require credible ambitious domestic mitigation efforts supported by robust measurement and analysis. Continued research support would be essential to this.

Cross-government coordination and engagement will be required to implement an effective and coherent approach. Enterprise strategy for the green economy should draw on the expertise and relationships developed in national engagement with the UNFCCC and in international development activities to advance green enterprise development at home.

## 5 Conclusions

As a Party to the UNFCCC and EU Member State, Ireland is committed to acting to prevent dangerous climate change. This means that its future emissions pathway should be consistent with ensuring that the global average temperature increase does not exceed 2°C. This implies a major transition for key sectors and activities, specifically for energy, transport, and agriculture.

This transition requires a long-term perspective with 2050 being an internationally recognised date for achievement of mitigation goals. Such a long-term perspective is necessary to inform planning and investments for critical infra-structure by key sectors, for example in power generation and transport. However, given the scale of the required transition, the long-term perspective needs to be coupled to immediate actions with the objective of putting Ireland on track to meet 2020 targets. It needs to:

- Support planning and investment;
- Enable engagement with global and regional markets;
- Avail of global opportunities and advance global partnerships.

This requires strategic planning to mainstream climate change thinking into key government departments, including those responsible for energy, transport, agriculture and innovation. Key elements of strategic planning could include:

- Adoption of a long-term goal for Ireland;
- Active engagement on EU policy, in particular the EU ETS;
- Identification of opportunities;
- Engaging the private sector;
- Research and innovation.

The science of climate change, as collated in the AR4, requires that substantial emissions reductions are achieved in developed countries by 2050. Decisions in the short term to meet 2020 targets will affect investment in long-life assets and research, and also long-term behavioural habits. These decisions will impact on the

cost of and possibilities for future mitigation measures. More certainty in the long-term path to a low-carbon economy will reduce the risk to low-carbon investment and thus allow significant cost reductions. A long-term perspective is crucial to decision-making in the short term in order to stay on the path to 2°C at a low and feasible cost.

Policy-makers need to provide increased certainty to investors about targets post-2020 to ensure that a robust carbon price is factored into investment decisions on long-life assets.

### 5.1 Adoption of a Long-term Goal

The path to 2°C requires at least 80% emissions reductions by 2050 by developed country parties. In 2009, EU heads of state adopted this as an objective. In anticipation of binding future requirements, Ireland could validly act now to adopt an ambitious nationally appropriate target. Current analysis suggests that sufficient measures and tools exist to achieve GHG neutrality by 2050. Modelling of the energy sector, including transport, shows that technologies and measures exist to achieve emissions reductions in excess of 80%. Research also suggests that soil carbon can act as a significant anthropogenic sink in Ireland. Sinks from the forestry sector together with the use of international carbon market mechanisms can also play a role. Early adoption of GHG neutrality by 2050 as a target will act as a spur to research and innovation in mitigation opportunities, particularly sinks and agriculture, ensuring Ireland is well placed to cope with binding future commitments.

A long-term perspective would also imply increasing ambition in the European ETS. Several analyses suggest that to achieve 2050 targets of GHG neutrality or even 80% emission reductions, the energy sector would need to decarbonise almost completely. The most cost-effective pathway to decarbonisation in the energy sector requires early action. According to analysis by the European Climate Foundation, a shift in investment patterns towards low- or zero-carbon technologies and infrastructure is required by 2015. Currently, the carbon

price is insufficient to promote such a shift in the EU ETS sector. The solution could be simple. Ambition in the ETS sector could be increased with a tightening of the emissions cap to increase the carbon price and to incentivise structural shift particularly. This would have the added benefits of, *inter alia*, increased auction revenues for government and improved energy security and air quality. The European Commission is concerned about the carbon price level and is preparing proposals in 2012 for 'reform' of the EU ETS, including delayed auctioning of allowances. The Irish government could support proposals for robust reform of the EU ETS and in particular a tightening of caps.

In the non-ETS sectors, a GHG neutrality target would imply undertaking mitigation actions now to embed emission reductions, to spur green economic growth and to reduce the cost of future compliance. Cross-sectoral planning is key – particularly for long-term land-use planning coherent with biomass and energy sector objectives.

## **5.2 Action on Climate Change Needs to be Seen as an Opportunity**

Global action on climate change and the transformation to a low-GHG global economy is an imperative. However, like previous and ongoing transformations to IT and mobile communications based economies, this can bring enormous opportunity and benefits. International obligations in climate finance, while representing a challenge in a constrained fiscal environment, also represent an opportunity. The Cancún agreement on US\$100bn climate finance annually by 2020 represents the creation of a large market for climate products and services in developing countries. New economic opportunities will arise from the demand for climate solutions, both mitigation and adaptation. Irish government intervention to mobilise climate finance in developing countries could bring co-benefits of domestic entrepreneurial development. Seizing these opportunities will facilitate green growth and job creation. Irish policy-makers need to consider how the Irish economy can organise itself to supply climate solutions. Building Ireland's reputation internationally in climate science and policy will give a higher profile to Irish climate industries in international markets. This

requires a proactive approach to the development of domestic climate policy and strategic engagement at international fora.

## **5.3 The Innovative Power of the Private Sector should be engaged in Domestic Mitigation**

A robust carbon price signal is a key measure to engage the private sector in mitigation measures. The EU ETS already achieves this to some extent via the market price for carbon (though ambition could be heightened). Applying a price to a broader base of GHG emissions in the non-ETS sector is also important. Various approaches can be taken. In particular, expanding the carbon tax to solid fuels such as coal and turf, which are the least carbon efficient, would be essential. However, extending the carbon tax beyond fuels can be difficult. In the short term, using a domestic offsetting or project approach to incentivising mitigation would create a high-profile positive price signal for the private-sector development of innovative approaches in all sectors. Private-sector mitigation initiatives would support long-term transformation to a sustainable GHG neutral economy by supporting the creation of new business models and green growth opportunities, including via exports.

Engaging the private sector in climate action, encouraging innovation, and generally taking a proactive approach to mitigation will enhance the Irish reputation for climate solutions. Efforts to enhance the climate reputation of Ireland will also have benefits for other economic sectors. The green credentials of products are important, particularly when competing in high end international industries such as food products. Enhancing Ireland's brand with robust green credentials will boost exports. Improving the Irish green brand will also increase Ireland's attractiveness for foreign direct investment and the location of internationally mobile offices. In addition to these economic benefits, domestic action on climate change can increase energy security, improve air quality, improve water quality and increase resource efficiency, all adding to a competitive economy and quality of life. It makes sense, even in constrained economic circumstances, to take an ambitious proactive approach to climate policy.

#### **5.4 Research and Innovation supports Mitigation Efforts and the Green Economy**

Research and innovation are crucial to advancing transition to a low-carbon economy and green economic growth. To attain ambitious mitigation targets in Ireland, significant reductions are required. This is a particular challenge for the agriculture sector. Research is required to develop feasible mitigation options for this sector. Greenhouse gas neutrality would require further research to develop robust accounting systems for carbon stocks in biomass, particularly in soils. Through addressing this challenge Ireland could become a knowledge leader in this area. Similarly, Ireland has the opportunity to become a world leader in renewable energy technologies, such as ocean energies, and smart grids to support the high penetration of renewable energies. Ireland also has potential to develop green economy opportunities from current climate, ocean and terrestrial observation requirements. Existing research investments based on Ireland's location on the Atlantic boundary of Europe mean that it already has a global

profile in this area. In combination, initiatives in these areas can act as a platform for strategic development of green economy technologies and associated markets.

Excellence in climate research would underpin the marketing of Ireland as a green exporter and a green location for business. Such a reputation would enhance Irish exports, for example of agricultural and food products, and generate interest in Irish knowledge products, such as education, analytical and consultancy services, offering further support to the development of a green economy.

Ireland should adopt a long-term cross-government climate change vision, including advancing progress in meeting climate goals as well as developing the green economy. The vision needs to be supported by domestic action, increased ambition in the EU ETS, accounting for sinks and engagement of the private sector. This vision must be supported by investment in research which will advance new options for mitigation and accounting, as well as enhancing Irish reputation in markets for climate goods and services.

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## **Acronyms**

AAU	Assigned Amount Unit (Kyoto Protocol)
AFOLU	Agriculture, Forestry and Other Land Use
AMC	Advance market commitment
CCGT	Combined cycle gas turbine
CCRP	Climate Change Research Programme
CCS	Carbon capture and storage
CDM	Clean Development Mechanism (Kyoto Protocol)
CER	Certified Emission Reduction unit (Kyoto Protocol)
DO	Domestic offsetting
DFA	Department of Foreign Affairs
EC	European Commission
EPA	Environmental Protection Agency
ERU	Emission reduction unit (Kyoto Protocol)
ESD	Effort Sharing Decision
ESRI	Economic and Social Research Institute
ETS	Emissions Trading Scheme
EU	European Union
FDI	Foreign direct investment
GDP	Gross domestic product
GHG	Greenhouse gas emissions
ICE	Internal combustion engine
IPCC	Intergovernmental Panel on Climate Change
JI	Joint Implementation (Kyoto Protocol)
LDC	Least developed country
MAC	Marginal abatement cost
MtC	Mega tonnes of carbon
MtCO <sub>2</sub> e	Mega tonnes of carbon dioxide equivalent
non-ETS	non-Emissions Trading Scheme
N <sub>2</sub> O	Nitrous oxide
NO <sub>2</sub>	Nitrogen dioxide
NPV	Net present value
ODA	Official Development Assistance

PM	Particulate matter
ppm	parts per million
R&D	Research and development
REDD	Reduced emissions from deforestation and degradation
SEAI	Sustainable Energy Authority of Ireland
SFI	Science Foundation Ireland
SID	Small Island Developing State
SME	Small and medium enterprises
TIMES	The Integrated MARKAL-EFOM System
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
WAM	With additional measures
WM	With measures