Draft National Mitigation Plan
MARCH 2017
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Ministerial Foreword

Climate Change is the global challenge of our generation. It presents significant challenges for Ireland and for the international community. We must meet these challenges head on if we are to achieve the transformation that will be required to enable us to transition effectively to a low carbon and climate resilient future. Each one of us has a role to play in meeting these challenges.

Development of Ireland’s first statutory National Mitigation Plan represents a hugely important first step by this Government in enabling transition in what will be a long journey with many different and complex elements to consider along the way. Ireland faces significant challenges in reducing its greenhouse gas emissions, the profile of which reflects both the particular structure of our economy as well as the outcome of curtailed public and private investment capacity over the course of recent years. The options available to us to reduce our emissions are neither straightforward nor cost-free. But there are options available that also have a range of additional possible benefits, for example in terms of employment potential, air quality improvements or healthier living and working environments. Ireland’s first National Mitigation Plan is therefore being prepared on the basis that it will be a whole-of-Government Plan, reflecting in particular the central roles of the key Ministers responsible for the sectors covered by the Plan - Electricity Generation, the Built Environment, Transport and Agriculture.

This draft plan is being issued for public consultation, in line with the provisions of the Climate Action and Low Carbon Development Act, 2015, to inform its further development before a final Plan is submitted to Government in June of this year. This document highlights several key questions for stakeholders to consider in terms of how best Ireland should position itself in taking this first step in achieving the national transition objective by 2050.

My ultimate objective is to have a coherent, holistic Plan that sets out exactly what Ireland is doing and is planning to do, to further our transition to a low carbon, climate resilient and environmentally sustainable economy by 2050. Importantly, it must be recognised that this first Plan cannot provide a complete roadmap to achieve the 2050 objective, but will begin the process of development of medium to long term options to ensure that we are well positioned to take the necessary actions in the next and future decades. This will be an ongoing process with the National Mitigation Plan becoming a living document. In addition there will be the formal preparation of successive National Mitigation Plans at least once every five years as provided for in the 2015 legislation. In this respect, this first Plan is a work in progress reflecting the reality of where we are in our decarbonisation transition.
A key part of developing the National Mitigation Plan has been the preparation of robust technical, environmental and economic analysis to evaluate the impacts of a range of different climate change mitigation options. This draft Plan presents this analysis on a sectoral basis in order to inform the debate as to what may or may not be feasible options for mitigation.

The Strategic Environmental Assessment Environmental Report and Appropriate Assessment Natura Impact Statement, which are being published together with this draft National Mitigation Plan, are also key components of the analytical underpinnings for the Plan and are to be read in conjunction with the draft Plan.

Alongside the publication of this draft Plan, I am establishing a National Dialogue on Climate Action. The objective of the National Dialogue is to provide an inclusive process to engage and seek consensus across society on enabling the transition to a low carbon and climate resilient future. While the National Dialogue will be an ongoing process, I do hope that early engagements through this process will also help to inform the public consultation on this draft National Mitigation Plan.

Denis Naughten, T.D.
Minister for Communications, Climate Action and Environment
Chapter 1  Climate Action and the Climate Challenge

1  Climate Action and the Climate Challenge

1.1  The Climate Challenge

One of the greatest global challenges for this and future generations is how we address climate change. Evidence for warming of the climate system is unequivocal and it is extremely likely that human activity has been the dominant cause of the observed warming since the mid-20th century. Observations show that global average temperatures have increased by almost 1 °C since pre-industrial times. The atmosphere and ocean have warmed, the amount of snow and ice has diminished and sea level has risen as the concentrations of greenhouse gases (GHG) have increased. The projections of future global and regional climate change indicate that continued emissions of GHGs will cause further warming and changes to the climate system\(^1\). Changes in Ireland’s climate are in line with these global trends.

Climate change is already having diverse and wide ranging impacts on Ireland’s environment, society, economic and natural resources. Future impacts are predicted to include sea level rise; more intense storms and rainfall; increased likelihood and magnitude of river and coastal flooding; water shortages in summer; increased risk of new pests and diseases; adverse impacts on water quality; and changes in distribution and time of lifecycle events of plant and animal species on land and in the oceans. Against this background, strategies must be devised to reduce and manage climate change risks through a combination of mitigation and adaptation responses.

We have a limited window for real action to ensure that current and future generations can live sustainably in a low carbon and climate resilient world. The climate change challenge cuts across all sectors of society and we all need to consider how best we can contribute to the solutions. Government is taking the lead in addressing this challenge and we must ensure that there is a sustained, considered and strategic approach to incremental and permanent decarbonisation involving all of Government and society. In this regard climate action should be seen as complementary to other important strategic objectives, such as addressing air pollution impacts on human health and achieving the globally agreed 2030 UN Sustainable Development Goals.

The first National Mitigation Plan (NMP) represents an initial step to set us on a pathway to achieve the level of decarbonisation required. In this context, Ireland’s first plan will not only contain measures to address the challenge to 2020, but equally importantly will also begin the development of medium to long term options to ensure that we are well positioned to take the necessary actions in the next and future decades. The first NMP will not represent a complete roadmap to achieve the 2050 objective, but rather will represent a work in progress reflecting the reality of where we are in our decarbonisation transition. It is intended that the NMP becomes a living document, accessible on the Department of Communications, Climate Action and Environment’s website, which is continually updated as ongoing analysis, dialogue and technological innovation generate more and more cost-effective sectoral mitigation options.

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1.2 Climate Action

The Global Response

Ireland is a party to both the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol, which together provide an international legal framework for addressing climate change. In December 2015, an ambitious new legally binding, global agreement on climate change was agreed in Paris. The Paris Agreement aims to restrict global temperature rise to well below 2°C above pre-industrial levels, and to pursue efforts to limit the temperature increase to 1.5°C. It aims to increase global ability to adapt to the adverse impacts of climate change and to foster climate resilience and low GHG emissions development, in a manner that does not threaten sustainable food production. It also seeks to achieve a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases in the second half of this century. The European Union ratified the Paris Agreement ahead of its Member States, triggering its entry into force on 4 November 2016, the same date the agreement was ratified by Ireland.

The Paris Agreement aims to tackle 95% of global emissions through 188 Nationally Determined Contributions (NDCs) which will increase in ambition over time. Ireland’s contribution to the Paris Agreement will be via the NDC tabled by the EU on behalf of its Member States. This is a binding EU target of an overall EU reduction of at least 40% in greenhouse gas emissions by 2030 compared to 1990 levels. The target will be delivered collectively by the EU with reductions in the Emissions Trading Scheme (ETS) and non-ETS sectors amounting to 43% and 30% by 2030 compared to 2005 respectively.

The EU Response

In February 2011, the European Council reconfirmed the EU objective of reducing GHG emissions by 80-95% by 2050 compared to 1990, in the context of necessary reductions according to the Intergovernmental Panel on Climate Change (IPCC), by developed countries as a group. While maintaining a focus on the long-term objective to 2050, the more immediate focus is on the period 2017-2020 and planning ahead for the period 2021-2030. In this context, the EU provided the legislative foundation for the 2013-2020 EU climate and energy agenda with the adoption of the EU 2020 Climate and Energy Package by the European Council in December 2008.
Figure 1.1 Scope of ETS Sector in Ireland

![Pie chart showing ETS and Non-ETS emissions](image)

Source: EPA

Figure 1.2 Total Emissions by Sector in Ireland (ETS and non-ETS) 2015

![Pie chart showing emissions by sector](image)

Source: EPA
ETS
The 2009 Emissions Trading Directive established a cap and trade system for GHG emissions associated with large industry and electricity generation installations across the EU. The EU ETS includes some 11,000 installations (101 currently in operation in Ireland of which 75 are industrial installations), with an installed capacity of more than 30MW. It covers about 45% of EU emissions, but only just over 25% of total emissions in Ireland.

Non-ETS – Effort Sharing
In parallel, the 2009 Effort Sharing Decision (ESD) (Decision No. 406/2009/EU) set individual Member State targets for non-ETS emissions (i.e. GHG emissions associated with heating in buildings, transport, agriculture, etc.). The target agreed for Ireland for the year 2020 is that non-ETS GHG emissions should be 20% below their level in 2005, compared to an EU average reduction of 10%. The non-ETS target is legally binding on the State.

Energy Targets
Under the 2009 Renewable Energy Directive, Ireland is obliged to deliver 16% of energy from renewable sources by 2020. This will be met by 40% from renewable electricity, 12% from renewable heat and 10% from the renewable transport sector. Ireland is also committed to a national target of improving our energy efficiency by 20% by 2020. Within this national target, the public sector is required to achieve energy savings of 33%. While Ireland’s national target of improving energy efficiency by 20% by 2020 is not legally binding, it is critical to our progress towards our statutory EU 2020 targets to reduce GHG emissions by 20% and meet 16% of our energy demand from renewable sources. Because our renewables target is a proportion of our overall energy demand, the less energy we use/the more energy efficient we are, the easier it makes it to meet the renewable energy target.

2030
In October 2014, the European Council reached political agreement on headline targets for the 2030 Climate and Energy Framework. In addition to climate targets, which form the basis of the EU NDC under the Paris Agreement, the agreement also included a binding target of at least 27% of renewable energy in the EU and an energy efficiency increase of at least 27%, to be reviewed by 2020 potentially raising the target to 30%, by 2030.

On 30 November 2016, the European Commission published the Clean Energy for all Europeans Package. Noting that the EU Renewables Directive will no longer apply post December 2020, the Package includes a proposal for a revised Renewable Energy Directive.

The revised Directive builds on the existing Directive and provides a framework for renewable energy development to 2030. Taking account of the political agreement reached by the European Council in October 2014 to increase EU energy from renewable energy to a level of ‘at least 27%’ by 2030, this target will be delivered through individual Member States’ contributions, guided by the need to deliver collectively for the EU. The EU-level target represents a fundamental shift away from legally binding national targets. The 2020 national renewable energy target of 16% for Ireland will become the baseline target out to 2030. Therefore, Ireland will have a renewable energy target of at least 16% in the period 2020-2030.
Challenge to 2020

A key objective of Ireland’s first NMP is to try and close the gap to our target under the ESD for 2020. As stated above, for the year 2020 itself, the target set is that emissions should be 20% below their value in 2005. This is jointly the most demanding 2020 reduction target allocated under the ESD, and one shared only by Denmark and Luxembourg. In addition, Ireland has a non-ETS GHG emissions reduction target for each year between 2013 and 2020. The 2013 target is based on the average of emissions for the years 2008-2010. The target for each of the years 2014 through to 2019 is on a straight-line trajectory between the targets for 2013 and 2020, and surpluses in one year can be used to cover deficits in any subsequent year. This effectively establishes a non-ETS GHG emissions budget over the period 2013-2020 of 338 million tonnes of carbon dioxide equivalent (Mt CO$_2$eq).

According to the latest provisional GHG inventory published by the Environmental Protection Agency (EPA) (November 2016), emissions for 2015 are estimated at 59.84 Mt CO$_2$eq, which is 3.7% higher than emissions in 2014. These figures indicate that Ireland will be in compliance with its 2015 annual limit under the ESD, but the latest projections indicate that Ireland will exceed its annual targets in 2016 or 2017 and over the remainder of the period to 2020.

Trends in emissions 1990-2015

An analysis of the trend in overall GHG emissions, by sector, shows that emissions in Ireland peaked in 2001 with emissions reductions in 8 of the last 10 years. However, the EPA reports that this was due to reduced economic activity and we are now seeing strong evidence that emissions are once again increasing in line with economic and employment growth, particularly in the transport sector.

Figure 1.3 GHG emissions by Sector 1990 - 2015

Source: EPA
Greenhouse gas emissions projections to 2020

The EPA produces GHG emission projections on an annual basis for all sectors of the economy. According to the latest projections produced by the EPA (March 2016), projected emissions for 2020 indicate that Ireland's emissions at that stage could be in the range of 6-11% below 2005 levels. The likely outcome will be closer to 6%, representing a significant shortfall in terms of reaching the 20% reduction in 2020. This reflects both our reduced investment capacity over the period of the economic downturn, as well as the fact that the target itself was misinformed and not consistent with what was achievable on an EU wide cost-effective basis².

In the interim, the EPA projections suggest that Ireland may have a cumulative deficit of units in 2018. Some of this deficit can be addressed by means of the retirement of Annual Emissions Allocations and units from the Kyoto Protocol Flexibility Mechanisms carried forward from 2008-2012. Over the period 2013-2020, the EPA projections for non-ETS GHG emissions are 350 Mt CO₂eq, indicating a ‘gap to target’ of 12 Mt CO₂eq. It is clear that further policies and measures beyond those that are already in place will be necessary to address compliance with Ireland's obligations under the 2009 ESD, in the first instance, but also to ensure that Ireland is on a sound pathway to permanent and incremental decarbonisation to achieve the national transition objective, specified in the Climate Action and Low Carbon Development Act 2015, by 2050.

Table 1.1 Gap to Non-ETS 2020 Target

<table>
<thead>
<tr>
<th>Gap to Non-ETS 2020 Target</th>
<th>Non-ETS Carbon Budget (Mt)</th>
<th>Gap (Mt)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013-2020</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Required per EPA 2016 BAU Scenario</td>
<td>350</td>
<td>–</td>
</tr>
<tr>
<td>20% Target</td>
<td>338</td>
<td>12</td>
</tr>
</tbody>
</table>

While reducing emissions is challenging for all sectors, the challenge is greater in some sectors, particularly the agriculture and transport sectors. Emissions in the agriculture sector are projected to increase by between 6-7% under modelled scenarios, in the period 2014 to 2020. For the transport sector, emissions are projected to increase by 10-16% under modelled scenarios over the same period. The respective increases are likely to be at the higher end. Where the technical analysis is sufficiently progressed, this draft NMP presents data on the cumulative mitigation potential of both measures in place and also measures under consideration as possible options for the short, medium and long term. Scenarios for how the gap to Ireland's 2020 target is impacted are key considerations for this on-going analysis³.

Energy Targets to 2020

While good progress has been made to date, meeting the 16% renewable energy target by 2020 remains challenging (see table below).

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³ The land use, land-use change and forestry sector is not included in the EU’s Effort Sharing Decision up to 2020
Chapter 1  Climate Action and the Climate Challenge

Table 1.2  Renewable Energy Gap to Target

<table>
<thead>
<tr>
<th>Sector</th>
<th>2015</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>GWh</td>
<td>RES (%)</td>
</tr>
<tr>
<td>Renewable Energy</td>
<td>12,116</td>
<td>9.1%</td>
</tr>
<tr>
<td>Renewable Transport</td>
<td>1,490</td>
<td>1.1%</td>
</tr>
<tr>
<td>Renewable Heat</td>
<td>3,335</td>
<td>2.5%</td>
</tr>
<tr>
<td>Renewable Electricity</td>
<td>7,291</td>
<td>5.5%</td>
</tr>
</tbody>
</table>

The SEAI has calculated that 25.3% of electricity, 6.5% of heat and 5.7% of transport energy requirements were met from renewable sources at the end of 2015. The SEAI analysis also shows that 9.1% of Ireland’s overall energy requirements in 2015 were met from renewable sources. The gap to target is 9,500 GWh, which is equivalent to 2.5 Mt CO\textsubscript{2}eq (for a single year in 2020) non-ETS emissions (if delivered by RES-H or RES-T).

With regard to our national target of improving our energy efficiency by 20% by 2020, we had achieved a 12% energy efficiency improvement at the end of 2015. Under a BAU scenario, this energy efficiency improvement is projected to increase to 15% by 2020. To end 2015 the public sector has achieved energy savings of 21% against a requirement to achieve energy savings of 33% by 2020.

Challenge to 2030

A proposal on the non-ETS targets for individual Member States, the Effort Sharing Regulation (ESR), was published by the European Commission in July 2016. The ESR proposal suggests a 39% GHG reduction target for Ireland, based on GDP per capita, for the period 2021 to 2030. This target is adjusted downward for cost-effectiveness by 9 percentage points to give a headline target of 30%. While this target is not yet agreed, it is clear that it will present an enormous challenge for Ireland, particularly with the likely outcome in 2020 being a 6% reduction in non-ETS emissions compared to our 20% emissions reduction target, as outlined above.

A useful way to examine the scale of this challenge is to focus on Ireland’s carbon budget (i.e. the amount of CO\textsubscript{2}eq that a country has agreed is the largest it will produce in a particular time period). The EPA’s BAU scenario (i.e. with no additional measures in place beyond those already in place) suggests that Ireland will require a carbon budget of 456 Mt CO\textsubscript{2}eq over the period 2021 to 2030. It is almost inevitable that this baseline carbon budget will be revised significantly upwards in the next iteration of EPA emissions projections. The table below summarises the impact of the proposed 2030 target on Ireland’s required carbon budget over the period 2021-2030.

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4 These projections are from the SEAI 2016 Baseline Scenario, which provides the basis for EPA Business As Usual (BAU) projections.
Table 1.3 Impact of ESR Proposal on Ireland

<table>
<thead>
<tr>
<th></th>
<th>Carbon Budget (Mt)</th>
<th>Gap (Mt)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Required per EPA’s BAU Scenario</td>
<td>456</td>
<td>–</td>
</tr>
<tr>
<td>39% Target</td>
<td>359</td>
<td>97</td>
</tr>
<tr>
<td>30% Target (reflecting 9% Cost-Effectiveness Adjustment)</td>
<td>383</td>
<td>73</td>
</tr>
</tbody>
</table>

This analysis suggests the bringing forward of additional measures with a cumulative GHG mitigation capacity of 73 Mt CO$_2$ eq over the period 2021 to 2030, requiring very substantial investment by both the public and private sectors, as well as a broad range of non-financial policy tools, including regulations, standards, education initiatives and targeted information campaigns. Work is ongoing to cost various suites of measures that could meet the 2030 target as cost-effectively as possible.

**National Policy and Long Term Vision**

The extent of the challenge to reduce GHG emissions in line with our International and EU obligations is well understood by Government and is reflected also in the *National Policy Position on Climate Action and Low Carbon Development (2014)* and the *Climate Action and Low Carbon Development Act 2015*. Both the policy position and legal framework are key elements of the effort to progress the national low carbon transition agenda.

The *National Policy Position* establishes the fundamental national objective of achieving transition to a competitive, low carbon, climate-resilient and environmentally sustainable economy by 2050. It sets out the context for the objective; clarifies the level of GHG mitigation ambition envisaged; and establishes the process to pursue and achieve the overall objective. Specifically, the *National Policy Position* envisages that policy development will be guided by a long-term vision based on:

- an aggregate reduction in carbon dioxide (CO$_2$) emissions of at least 80% (compared to 1990 levels) by 2050 across the electricity generation, built environment and transport sectors; and
- in parallel, an approach to carbon neutrality in the agriculture and land-use sector, including forestry, which does not compromise capacity for sustainable food production.

As envisaged by the *National Policy Position*, the evolution of climate policy in Ireland will be a dynamic, iterative process, based on the adoption by Government of a series of national mitigation plans and national adaptation frameworks over the period to 2050 with the ultimate objective of successive Plans and Frameworks incrementally achieving the national transition objective by 2050. The plans will be continually updated, as well as being reviewed on a structured basis at appropriate intervals, and at a minimum, every five years. This will include early identification and ongoing updating of possible transition pathways to 2050 to inform sectoral strategic choices.
The *Climate Action and Low Carbon Development Act 2015* provides the statutory basis for the national transition objective. As provided for in the 2015 Act, in order to pursue and achieve the national transition objective, the Minister for Communications, Climate Action and Environment must make and submit to Government a series of successive National Mitigation Plans (NMPs) and National Adaptation Frameworks (NAFs). When considering these plans and frameworks, Government must ensure that the national transition objective is achieved by the implementation of measures that are cost-effective. The Act provides that the first NMP must be submitted to Government no later than 10 June 2017.

The White Paper on Energy Policy, *Ireland's Transition to a Low Carbon Energy Future 2015-2030*, published in 2015, sets out a framework to guide energy policy in the period to 2030. The White Paper recognises that a radical transformation of our energy system is required to meet our national, EU and international climate objectives and sets a course for an energy sector where the State will provide the supports that enable consumers to become active energy citizens. It posits a policy approach where our energy system will change from one that is almost exclusively led by Government and utilities to one where individuals and communities are agents of change in the way Ireland generates, transmits, stores, conserves and uses energy. It sets out a vision, a framework and over 90 actions for Irish energy policy up to 2030 as we transition to a low carbon society and economy by 2050. The vision is to reduce greenhouse gas emissions from the energy sector by between 80% and 95% compared to 1990 levels by 2050 while ensuring that secure supplies of competitive and affordable energy remain available to our citizens and businesses. Achieving this vision will be key to the achievement of the national transition objective.

The development and implementation of policy will be guided by five principles:

- the citizen will be at the centre of the transition and the energy industry;
- the transition will be underpinned by policy and regulation that is stable and predictable;
- policy will seek to achieve optimum benefits at least cost, while recognising that decarbonisation will both incur costs and deliver benefits;
- policy measures will be evidence based and subject to rigorous analysis and appraisal prior to being implemented;
- new technologies, services, energy network architectures and community-based energy initiatives will emerge to facilitate and drive the transition.

The White Paper sets out how the energy transition will see accelerated and diversified renewable energy generation, and a renewed impetus on energy efficiency. This will be facilitated by strong regulation, effective markets, appropriate infrastructure, and deeper cooperation with our partners in Northern Ireland and the EU.
Enabling the National Transition

The pursuit of the national transition objective is overseen by the Cabinet Committee on Infrastructure, Climate Action and the Environment which is chaired by the Taoiseach. Independent advice is provided by the Climate Change Advisory Council (CCAC), established under the Climate Action and Low Carbon Development Act 2015. Technical support for the development and management of key operational elements in the national climate and energy policy process is provided by the Technical Research and Modelling Group (TRAM). TRAM has assisted the Government in developing this NMP, and in informing negotiations with the European Commission relating to Member State targets for distributing the EU 2030 30% target reduction in non-ETS GHG emissions.

A significant challenge lies ahead for Ireland in achieving the national transition objective. It is now clear that we will fall short of reaching a 20% reduction in non-ETS GHG emissions by 2020. This first NMP will provide the mechanism to begin addressing this challenge from both central and sectoral perspectives. This NMP will do this in a manner that also takes into account the current deliberations regarding the non-ETS GHG emissions target for 2030.

The NMP must specify the policy measures that Government consider are required to manage GHG emissions and the removal of GHGs at a level that is appropriate for furthering the national transition objective. Given that this long-term objective must be achieved by 2050, it is not prudent or even possible to specify, in detail, policy measures to cover this entire period as we cannot be certain what scientific or technical developments and advancements might arise over the next 30 years or so. This does not mean that inaction or a ‘wait and see’ approach is appropriate either, but rather arrangements must be in place to ensure that sound decision-making from a technical and economic perspective can be made based on rigorous analysis and assumptions which can be reviewed, as appropriate, in light of technical and scientific advances.

In this respect, it is important to acknowledge that Ireland’s first NMP represents a critical first step towards achieving the national transition objective and for this reason, policy development will necessarily be ongoing with the Government, subject to budgetary considerations, adopting appropriate mitigation options so as to facilitate the successful implementation of mitigation measures in each of the four key sectors. In this context, there are also some key cross-cutting actions to be undertaken as follows:

- **Continue to build an appropriate research and technical and economic advisory infrastructure:** An appropriate permanent technical and economic advisory infrastructure is essential to support the development of cost-effective measures which deliver the optimal mitigation potential, exploit economic opportunities and safeguard our economic recovery. In this context, the TRAM was established in 2015.

  **Timeline:** Ongoing

- **Undertake a review of guidance on public expenditure appraisal and evaluation to ensure their suitability to capturing key costs and benefits of climate change measures:** The Public Spending Code sets out detailed guidelines for public bodies on appraisal and evaluation of public expenditure programmes. The Code also includes detailed guidelines on cost benefit analysis. A review of this guidance is necessary to ensure that it provides the best available advice to public bodies on measuring and reporting on the costs and benefits associated with climate change measures.

  **Timeline:** 2018
Identify initial possible transition pathways to 2050 to inform sectoral strategic choices: This will facilitate the provision of an initial roadmap to achieve the 2050 mitigation objective set out in the National Policy Position and, in doing so, further assist in identifying policies and measures to meet intermediate targets agreed at EU level for 2020 and 2030. Such a roadmap, which will be subject to revision in the light of scientific or technical developments, should assist in establishing the required stable policy framework at sectoral level needed to achieve the 2050 objective in a cost-effective manner.

Timeline: 2018

Identify options for pricing carbon emissions, in particular in relation to carbon tax: The Government is actively inputting into the proposals to reform the EU ETS with a view to it delivering an appropriate carbon price signal to advance decarbonisation of the ETS sector. The introduction of a national carbon tax on fossil fuels in 2009, on a phased basis, was a major step forward in putting a price on carbon for the rest of the domestic economy (i.e. non-ETS sector). Government is cognisant that the carbon tax, as part of the broader suite of policy measures, has a key role to play in the transition to a low carbon society by 2050 and the Department of Finance will undertake further analysis to inform the policy direction of the tax. In this regard, a clear long-term signal on carbon tax and the pathway towards reaching it is vital.

Timeline: 2018/Ongoing

Prepare options for the removal of fossil fuel subsidies: There are many supports which either directly or indirectly subsidise the continued use of fossil fuels. These need to be identified and options for their removal analysed. The particular issue of PSO support for peat-powered power stations is dealt with in Chapter 2.

Timeline: 2018/Ongoing

Evaluate exchequer and non-exchequer options for financing Ireland’s transition to a low carbon economy: Funding climate action to the required level presents an enormous challenge for Ireland. Early action is imperative to find the most cost-efficient and cost-effective solutions. However, finding the appropriate and most equitable manner to address this issue is not going to be easy particularly given the economic circumstances of recent years and where finances are still continuing to stabilise and recover. A whole-of-Government approach is essential in terms of identifying an optimal mix of public, private, societal and taxation mechanisms to enable an effective transition.

Reliance solely on Exchequer-funded grant schemes is neither affordable nor adequate to the scale of the challenge to be addressed. Where such measures are listed as being ‘under consideration’ in this document, it is important to recognise that this is an indicative list of options based on preliminary analysis and consideration is, therefore, at an early stage. Further economic analysis is underway on these measures and others, with more options to be added to the list on an ongoing basis once the final NMP is published. Ultimately, decisions on whether to proceed with measures or not will take place in the context of Government prioritisation as part of expenditure planning, including as part of the current spending review and mid-term review of the Capital Plan Building on Recovery: Infrastructure and Capital Investment 2016-2021, and the budgetary and estimates processes.

Timeline: 2017/Ongoing
- Evaluate non-financial options for Ireland’s transition to a low carbon economy: Following on from the above action, it is important that the full range of policy tools be brought to bear on the challenge. Consideration must be given to the role of regulations, standards, education initiatives and targeted information campaigns. Some initiatives in these areas are outlined in this draft plan.

  **Timeline:** 2017/Ongoing

- Prepare periodic reports on the competitiveness implications of Ireland’s transition to a low carbon economy: Energy cost competitiveness can directly affect the ability of enterprise to retain and grow output and employment, particularly in energy intensive sectors. A reliable and competitively priced supply of energy is vital for business and its ability to compete successfully in international markets. The Energy White Paper places an emphasis on competitiveness alongside sustainability and security of supply objectives. From a competitiveness perspective it is important that mitigation strategies seek to achieve optimum benefits at least cost, and to ensure that policy measures are evidence-based and subject to rigorous analysis and appraisal prior to being implemented.

  **Timeline:** 2017/Ongoing

- Ensure appropriate structures and processes are in place to coordinate necessary Research, Development and Innovation, and to support environmentally sustainable economic opportunities, including preparation of a scoping report: Research, development and innovation will play a key role in achieving Ireland’s transition to a low carbon economy and society. The development and adoption of new and existing green technologies will be vital in areas ranging from energy efficiency, to electricity generation, transport and agriculture. Alongside efforts to spur further technological innovation, research will also need to focus on non-technological innovations including barriers to institutional and individual behavioural change. Innovations in firm business models and services provision, along with research aimed at modelling future scenarios and monitoring progress, will also be important.

  Furthermore, key considerations in the development of the NMP, and underpinned in the Climate Action and Low Carbon Development Act 2015, include the need to promote sustainable development and the need to take advantage of environmentally sustainable economic opportunities both within and outside the State. Business and innovators will play a pivotal role in this regard and Government for their part must ensure that policy evolves in such a way as to ensure that there is an enabling environment for businesses and innovators to make the necessary investments for our low carbon, sustainable future.

  **Timeline:** 2017/Ongoing
- **Implement National Dialogue Proposal on Climate Action:** It is essential that we put in place a system of community engagement to build public support for the action plans that we need to put in place over the coming years and decades. The Programme for a Partnership Government commits to establishing a National Dialogue on Climate Action (NDCA). This will subsume the National Energy Forum, which is a key action of the Energy White Paper. Given the long term nature of climate action, much still needs to be settled in terms of long-term policy direction and, in this context, a national dialogue is timely and will be a useful tool to engage people with the challenge of climate change; motivate changes in behaviour; and create structures at local, regional and national levels to support the generation of ideas and their translation into appropriate cost-effective actions. Full details are published on the Department of Communications, Climate Action and Environment's website.
  
  **Timeline:** 2017/2018

- **Ensure the climate implications of spatial choices are fully considered:** Spatial planning can make a significant contribution to addressing climate and energy obligations by helping to shape new and existing developments in ways that reduce greenhouse gas emissions, increase resilience to the impacts of climate change and enable renewable energy obligations to be met. In this regard, it will be critically important that a coordinated and coherent approach to integrating the on-going development of both the NDCA and ‘Ireland 2040 – Our Plan’ (National Panning Framework – NPF) is adopted. The planning of NDCA events will provide for mutual participation in respective NDCA and NPF consultation events. This should assist in enhancing the role of local authorities in climate action.
  
  **Timeline:** 2017/2018/Ongoing

- **Undertake a review of Ireland’s climate science research capacity:** Ireland’s climate science research infrastructure is a key resource for informing policy development for both mitigation and adaptation. It also enables Ireland to contribute to ongoing international efforts in relation to climate science research, observation and analysis. A review will be undertaken to ensure the existing research capacity is optimally positioned to develop into the future.
  
  **Timeline:** 2018/Ongoing
1.3 Conclusion

As stated above, the development of Ireland’s first statutory NMP is an iterative process and is statutorily designed to represent a whole-of-Government approach. This process is ongoing and involves significant cross-Departmental engagement at different levels to ensure a coherent, holistic plan is prepared that sets out clearly how Ireland is going to transition to a low carbon, climate resilient and environmentally sustainable economy.

Technical, environmental and economic analyses are on-going and will continue to be a critical element informing the overall process in terms of underpinning the iterative approach to the development of the plan. In this regard, it is important to note that the environmental analysis has also been prioritised so as to inform the accompanying draft Strategic Environmental Assessment (SEA) Environmental Report and Appropriate Assessment (AA) Natura Impact Statement which are critical inputs in terms of ensuring that environmental concerns are adequately integrated into the decision-making and implementation process at both sectoral and national level.

It is hoped therefore that providing this draft NMP will allow all relevant stakeholders and the public time to consider and reflect on the key issues being discussed in the subsequent chapters and on the key questions and policy options set out for each sector in Annex 1. This should enable an informed consultation process, including on the SEA and AA draft reports which are also being issued for consultation prior to a final NMP being submitted to Government for approval and finalisation of the SEA and AA reports in June 2017.
2 Decarbonising Electricity Generation

2.1 Introduction

Energy is indispensable to contemporary social and economic functioning, while energy policy seeks to balance the sometimes competing aspects of sustainability, competitiveness and security of supply. Given the scale, scope and extent of energy use, it inevitably has significant environmental aspects including GHG emissions arising from power generation, heating and transport. Harnessing our renewable energy resources will play a key role in the transition towards a sustainable, secure and competitive energy system. A key sector in this transition is electricity generation which since 2005, has been subject to the EU’s ETS.

While representing just under a third of emissions from the energy sector\(^5\), electricity has been an area of considerable decarbonising success and a target area for future progress. Under the Renewable Energy Directive 2009/28/EC, Ireland is legally bound to deliver 16% of its final energy requirements from renewable sources by 2020. Ireland has committed to meeting this overall renewable target by achieving 40% renewable electricity, 12% renewable heat and 10% renewable transport by 2020. It is to be noted, however, that while meeting the renewables share in electricity consumption reduces the ETS emissions of the power generation sector, it does not contribute to the non-ETS emissions reduction target.

Ireland is also committed to an EU-wide non-binding national energy efficiency target of 20% to be achieved by 2020. Meeting the 40% target for renewable electricity is equivalent to approximately 6% to 7% of total energy consumed in Ireland. The greater the volume of energy consumed, the greater the quantity of renewables required to meet the target. It follows that the EU's non-binding energy efficiency target, of 20% by 2020, is of critical importance to meeting our renewable targets, as meeting the efficiency target will reduce our requirement for renewable energy to meet the overall 16% target.

Strong progress is being made towards increasing the share of indigenous renewable energy in our electricity generation portfolio. Analysis by the SEAI for the year 2015, indicates that 9.1% of Ireland’s gross final energy consumption was met by renewable energy, with 25.3% of electricity demand produced from renewable energy sources. The EU 2017 Renewable Energy Progress Report\(^6\), projecting renewable energy deployment for individual Member States out to 2020, plots a trajectory of 15.5% for Ireland. To date, wind energy has been the largest driver of growth in renewable electricity. The total amount of renewable generation connected to the grid at December 2016 was 3,120MW, of which wind generation was approximately 2,796MW, hydro was 238MW and biomass was 86MW.\(^7\) This leaves a requirement for a further 880MW to be installed by 2020 if the 2020 electricity target is to be reached, requiring an increased rate of installation.

Looking beyond 2020, an EU target of ‘at least 27%’ is set for the share of renewable energy consumed in the EU in 2030. This target will be binding at EU level. It is to be met through individual Member States’ contributions guided by the need to deliver collectively

\(^{5}\) Data source: ‘Energy Related Emissions in Ireland’ (SEAI 2016).
\(^{7}\) Data source: Eirgrid and ESB Networks.
the EU target but without preventing Member States from setting their own national targets and supporting them, in line with the state aid guidelines, as well as taking into account their degree of integration in the internal energy market. The proposed revised Renewable Energy Directive does indicate that Member States cannot reduce the renewable share of energy use below the target for 2020, i.e. Ireland will have a target of at least 16% in the period 2020-2030. Electricity interconnection and reinforcement of internal lines are identified in EU policy as necessary to reinforce the single energy market\(^8\) and rising levels of intermittent renewables will require a more interconnected internal energy market and appropriate back up, which will need to be coordinated as necessary at regional level. An indicative target has also been set at EU level for at least a 27% improvement in energy efficiency in 2030. This is to be reviewed by 2020, with a view to revising the EU level target to 30%. The important interrelationship between renewable energy and energy efficiency targets has already been noted, and energy efficiency will be picked up in more detail in Chapter 3. Finally, it is not intended that the EU’s 2030 renewable energy and energy efficiency targets be translated into nationally binding targets.

### 2.2 Emissions Profile

Data produced by the SEAI shows that energy sector related emissions\(^9\) in Ireland accounted for 60% of GHG emissions in 2015\(^10\). These energy related emissions are attributed to transport accounting for 37%, heat 31% and electricity 31%. This breakdown is likely to remain unchanged out to 2020.

While the carbon impact of electricity generation has almost halved between 1990 and 2015, further reducing the carbon intensity of the electricity generation sector remains a challenge for the energy sector. Analysis by the SEAI further shows that since 1990, the share of high carbon content fuels in electricity generation, such as coal and oil, has been reducing with a corresponding rise in the relatively lower carbon natural gas and zero carbon renewables (imported electricity is considered zero carbon in terms of reporting national GHG emissions under international and EU reporting obligations). Over the period 1990 to 2014, the carbon intensity of Ireland’s electricity dropped by 49%, from 896 g CO\(_2\)/kWh in 1990 to a new low of 456 g CO\(_2\)/kWh in 2014. However, over the long term, this trend can and does vary in individual years because of market forces, such as dislocation in fuel supply or generation capacity. For example, in 2015 the CO\(_2\) intensity of electricity increased by 2.5% to 467.5 g CO\(_2\)/kWh primarily as a result of the 19.6% increase in coal used for generation. SEAI has also estimated that renewables in electricity generation avoided greenhouse gas emissions of 3,188 ktCO\(_2\) in 2015\(^11\). This however does not contribute to our 2020 national emissions reduction target as previously mentioned as the target relates to non-ETS emissions only. The figure below shows the trend in CO\(_2\) emissions per KWh of electricity supplied since 1990, with contributions by fuel\(^12\).


\(^9\) The energy sector encompasses electricity generation, oil refining, briquetting etc., and also industry, transport, residential, commercial/public and agriculture and fisheries sectors. Energy in Ireland 1990-2015 SEAI November 2016.

\(^10\) ENERGY-RELATED EMISSIONS IN IRELAND (2016 REPORT), SEAI, October 2016.

\(^11\) Renewable Electricity in Ireland 2015, SEAI, August 2016.

Chapter 2: Decarbonising Electricity Generation

Figure 2.1 CO₂ Emissions per kWh of Electricity Supplied with Contributions by Fuel

The following table shows individual generation intensity, benchmarking the trend from 2010 against 2005 data:

Table 2.1 CO₂ Intensity (g CO₂/kWh)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal</td>
<td>0.868</td>
<td>0.950</td>
<td>0.908</td>
<td>0.906</td>
<td>0.889</td>
<td>0.934</td>
<td>0.907</td>
</tr>
<tr>
<td>Peat</td>
<td>0.987</td>
<td>1.08</td>
<td>1.085</td>
<td>1.100</td>
<td>1.069</td>
<td>1.060</td>
<td>1.059</td>
</tr>
<tr>
<td>Oil</td>
<td>0.752</td>
<td>0.712</td>
<td>0.723</td>
<td>0.725</td>
<td>0.705</td>
<td>0.723</td>
<td>0.660</td>
</tr>
<tr>
<td>Fuel Oil</td>
<td>0.744</td>
<td>0.793</td>
<td>0.813</td>
<td>0.799</td>
<td>0.776</td>
<td>0.789</td>
<td>0.763</td>
</tr>
<tr>
<td>Gasoil/Diesel/DERV</td>
<td>0.917</td>
<td>0.572</td>
<td>0.643</td>
<td>0.616</td>
<td>0.664</td>
<td>0.616</td>
<td>0.532</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>0.419</td>
<td>0.400</td>
<td>0.387</td>
<td>0.384</td>
<td>0.381</td>
<td>0.373</td>
<td>0.367</td>
</tr>
<tr>
<td>Public Power Plants</td>
<td>0.419</td>
<td>0.407</td>
<td>0.397</td>
<td>0.393</td>
<td>0.391</td>
<td>0.384</td>
<td>0.375</td>
</tr>
<tr>
<td>CHP</td>
<td>0.407</td>
<td>0.337</td>
<td>0.314</td>
<td>0.326</td>
<td>0.323</td>
<td>0.312</td>
<td>0.327</td>
</tr>
<tr>
<td><strong>Overall (gross) Intensity</strong></td>
<td>0.554</td>
<td>0.468</td>
<td>0.435</td>
<td>0.467</td>
<td>0.411</td>
<td>0.404</td>
<td>0.415</td>
</tr>
</tbody>
</table>

Source: SEAI
While Ireland has a pipeline of projects in place to achieve 40% renewable electricity by 2020, reaching this milestone is becoming increasingly challenging, with a need to ensure timely deployment by facilitating increased community acceptance, and more efficient and effective planning and regulation. Achieving 40% renewable electricity is estimated to result in cumulative GHG emission reductions of 22.06 MtCO$_2$ in 2020.

Regarding the period 2021 to 2030, Ireland has yet to determine the exact contribution renewable energy will make towards progressing the transition towards a low carbon society and economy. While the EU target of an ‘at least’ a 27% share of renewable energy consumed in 2030 has already been noted, Ireland may, in the period to 2030, need to progress significantly beyond the 16% target for 2020, in order to avoid significant deviation from the necessary path to decarbonising by 2050.

Decarbonisation of the energy sector is likely to cause an increase in electricity demand due to fuel switching in the transport and buildings sectors. Renewables penetration of electricity generation in 2030 has also yet to be determined, making it difficult to project the timing and quantum of new renewable generation coming on stream, and the amount of GHG emissions that it will avoid over the period. Assuming that it will be at least maintained at 40%, this will result in cumulative GHG emission reductions of 65.60 MtCO$_2$ in 2030. A move beyond 40% renewable electricity may be required to maintain a reasonable trajectory to 2050, particularly as decarbonisation of large scale electric power generation provides options to decarbonise sectors such as heating and transport through electrification.

### 2.3 Opportunities and Challenges


As already referenced, the 2015 Energy White Paper sets out a vision to guide Irish energy policy and the actions that Government intends to take in the energy sector from now up to 2030, aimed at transforming Ireland’s fossil-fuel based energy sector into a clean, low carbon system by 2050. It aligns with the global and EU response to meeting the climate change challenge and sets out how the energy transition will see accelerated and diversified renewable energy generation, and a renewed impetus on energy efficiency.

As regards the electricity sector, the White Paper recognises that achievement of a low carbon future – while recognising policy objectives of sustainability, security of supply and competitiveness – will involve –

- generating our electricity from renewable sources of which we have a plentiful indigenous supply,
- moving from more carbon intensive fossil fuel generation to lower emissions fuels, and
- increasing the use of electricity and bioenergy to heat our homes and fuel our transport.
The transition will impact on the lives of our citizens and energy consumers alike and will require appropriate renewable energy infrastructure and technologies capable of providing the necessary services to meet the challenge. The active engagement of Ireland’s citizens and communities will be critical to guiding society-wide efforts to transform our energy system. Individuals and communities will become agents of change in the way Ireland generates, transmits, stores, conserves and uses energy. Other enabling factors that are recognised in the policy paper are strong regulation, effective markets and deeper cooperation with our partners in Northern Ireland and the EU.

**Abundant, Diverse and Indigenous Renewable Energy Resources**

Ireland has abundant, diverse and indigenous renewable energy resources, which will be critical to decarbonising our energy system, including electricity generation. Onshore wind has to date been the most cost-competitive renewable electricity technology in Ireland, accounting for 22.8% of overall electricity generation in 2015. In addition to our onshore wind resource, bioenergy, solar, offshore wind and other technologies can play a role in Ireland’s renewable energy mix. It is intended to diversify, having regard to cost efficiency and effectiveness criteria, our renewable generation portfolio over the period between 2020 and 2030.

**Bioenergy**

The Draft Bioenergy Plan, published in 2014, identifies that while biomass will play a role in renewable electricity, it is likely to make a more significant contribution to the heating and transport sectors where fewer alternative technologies are available. The final Bioenergy Plan, which is currently being developed, will underpin the development of the bioenergy sector in the period out to 2020 and lay the foundations for its longer term growth. The Plan seeks to form a link between critical policy areas for Ireland, namely, renewable energy; agriculture; forestry; the environment; sustainability; and the growth potential of the green economy; while taking account of international development policy considerations. In this way, it is intended that the Bioenergy Plan will provide a mechanism to inform and coordinate policy and implementation across these policy areas, thus supporting the sustainable exploitation of Ireland’s bioenergy resources.

**Offshore Energy**

Ireland has a landmass of around 90,000 square kilometres, but it also has a sea area around 10 times that size at 900,000 square kilometres. With one of the best offshore renewable energy (wind, wave and tidal) resources in the world, there is very significant potential in utilising these resources to generate carbon-free renewable electricity. The development of this offshore renewable energy resource will have an important role in Ireland’s longer-term renewable energy mix, as technologies develop and become more cost competitive. At present, there are a number of companies actively involved in developing offshore wind energy projects. In February 2014, the Government published the Offshore Renewable Energy Development Plan (OREDP). The overall conclusion of the Strategic Environmental Assessment underpinning the OREDP is that it would be possible to achieve up to 4,500MW from offshore wind and 1,500MW from wave and tidal devices, without impacting significantly on the environment. The Plan provides for Exchequer support for ocean research, development and demonstration, focussed in particular on supporting wave energy becoming market ready.
Community Engagement, Participation and Acceptance, Spatial Planning and Regulation

A fully joined up and integrated approach, involving public sector bodies at national, regional and local level, will be necessary to address existing legitimate community concerns, and obstacles and delays that might hinder the achievement of low carbon targets for electricity generation. In particular, the expansion of renewable electricity and other forms of renewable energy raises issues of community engagement, participation and acceptance. While investment in infrastructure is an essential precondition for the expansion of renewable energy, community concerns have been raised in relation to the provision of this energy infrastructure. Effective community engagement is essential for building public confidence and will help Ireland achieve our transition to renewable electricity. In the context of development of the new renewable electricity support scheme, DCCAE is working with relevant agencies and industry to develop approaches to community engagement, including potential support for micro generation. The development of an inclusive process of public participation, where local communities engage in the planning process, will be critical in shaping the energy transition. A number of regulatory initiatives are picked up in the following sections.

Financing and Delivering Renewable Electricity Projects

Growing our renewable generation portfolio is critically dependent on the timely delivery of projects by industry. Industry is in turn dependent on the willingness of financial institutions to provide funding. Lack of early and meaningful engagement by industry with local communities has often resulted in lengthy planning processes, and legal challenges by third parties to planning authorisations, increasing the risks faced by industry and financial institutions. This in turn has slowed down the rate of build of new onshore generation.

Enhancing the Grid

Increasing the share of renewables coming on to our electricity network requires both expansion and upgrading of the grid. While considerable enhancement of Ireland’s electricity grid has already taken place, further investment will be required. EirGrid’s new Grid Development Strategy and its DS3 Programme will be central to this effort. The DS3 Programme seeks to increase the share of variable renewable electricity that the all-island system can accommodate at any instant from current levels of 60% up to 75% by 2020. Ireland is currently leading the world with respect to the amount of non-synchronous variable renewable electricity integration onto a single alternating current power system. Implementation of this programme will facilitate management of a more secure power system with increasing volumes of variable electricity. The changes required to realise this 75% target involve both technical innovation and changes in the way electricity plants are managed. As regards the latter, the DS3 Programme supports the development of incentives for better plant performance. This 75% threshold for instantaneous variable renewable electricity integration is critical if we are to achieve the annual target of 40% renewable electricity by 2020. Moving beyond the 75% target threshold is a further key challenge for the period beyond 2020.
Chapter 2  Decarbonising Electricity Generation

Interconnection

Electricity interconnection and reinforcement of internal lines are identified in EU policy as necessary to reinforce the single energy market\(^\text{13}\). In this context, the integration of Ireland’s electricity system into that of Northern Ireland, Great Britain and mainland Europe through enhanced interconnection can facilitate increased variable renewable generation on the Irish system, as well as increasing security of supply.

The EU has set a 10% electricity interconnection target to be achieved by 2020. Ireland’s level of interconnection is currently 9%. An interconnection target of 15% is to be achieved by individual Member States by 2030. Ireland has one electricity interconnector to Wales, and Northern Ireland has one interconnector to Scotland. The electricity systems of Ireland and Northern Ireland are joined by one electricity interconnector of scale. A second interconnector (the North-South 400kV Interconnector project) has planning consent in Ireland, but is currently in the planning process in Northern Ireland. In addition, there are further interconnection initiatives with Great Britain and mainland Europe underway. These are still at the early stages and, if progressed will lay the foundations for further interconnection post-2020.

Brexit and the Single Electricity Market

Brexit is, due to the close links between Ireland and the UK, the most significant economic and social challenge of the past 50 years impacting Ireland’s economy and society.

One of the key links between Ireland and the UK is energy. Ireland imports most of the energy it uses and the UK is a key conduit for much of this energy. In addition, there are close energy links between Ireland and Northern Ireland, most notably the Single Electricity Market across the island of Ireland. The energy relationship Ireland has with the UK is unique when compared to other European countries and other sectors. Although other European countries have significant energy relationships with the UK, no country has the level of reliance of Ireland. Furthermore, the energy sector is unique – while many sectors of the Irish economy have high levels of trade with the UK, the energy sector has one of the highest levels of interdependence with the UK.

Energy is therefore necessarily identified as a high priority in terms of the arrangements to be agreed in the context of the UK’s Brexit decision and, in this context, the following priorities have been identified:

- Maintaining the Single Electricity Market across the island of Ireland
- Maintaining trade in secure supplies of energy between the UK and Member States
- Accommodating ability to meet EU obligations
- Supporting energy infrastructure

It is to be noted that, until exit negotiations are concluded, the United Kingdom remains a full member of the EU and all the rights and obligations of EU membership remain in force.

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Competitiveness

The European Energy Union is about more than energy and climate alone. It is about accelerating the modernisation of Europe’s entire economy, making it low carbon and efficient in energy resources, in a socially fair manner\(^{14}\).

It is important to recognise that increasing the share of renewables on our grid will impact on the cost of electricity and must therefore be undertaken in the most cost-effective way possible to maintain Ireland’s economic competitiveness. The costs of grid enhancement, interconnection, and electricity support schemes make their way onto our electricity bills. Electricity support schemes are funded through the Public Service Obligation (PSO) levy on all electricity consumers. Accurately projecting future PSO costs can be challenging due to a range of factors such as fluctuating electricity prices, varying capacity prices, the future share of renewables, and the termination of PSO contracts.

Integrated Single Electricity Market (I-SEM)

The creation of a fully integrated electricity market across the EU is one of the medium term goals of the Third Energy Package. The vision will be realised by way of the implementation of common EU guidelines, procedures and codes across the EU to allow electricity and gas to be traded freely across the Union.

The Single Electricity Market (SEM) Committee for the island of Ireland is proceeding with an inclusive process to arrive at an EU compliant solution for the SEM known as I-SEM. The aim is to ensure that Ireland can obtain the benefits of EU electricity integration in a compliant manner and maintain as far as possible the positive aspects of the SEM. While there are policy decisions associated with integrating the existing renewables arrangements, such as support schemes, into the new market structures, it is expected that over time the I-SEM will increase the efficiency of the electricity market.

Coal and Peat

In 2012, high gas prices and low coal and ETS prices resulted in more coal and peat being used for electricity generation in Ireland. In 2015, consumption of coal for electricity generation increased by 19.6% to 1,127 ktoe. However, the share of coal used in electricity generation reduced from 40% in 1990 to 25% in 2015. Coal use was at its lowest in 2009 at 775 ktoe but increased by 50%, to 1,160 ktoe, in 2012. Peat consumption in electricity generation increased by 0.8%, to 554 ktoe, in 2015 and accounted for 12.3% of the fuel inputs to electricity generation\(^{15}\). As previously stated, the overarching objective of the Energy White Paper is to transition to a low carbon energy system which provides secure supplies of competitive and affordable energy to citizens and businesses. This will ultimately involve moving away from higher emission fuel types to lower emissions fuels such as gas, or zero carbon renewable energy technologies. As well as implementing domestic climate mitigation policy measures, reducing the carbon intensity of electricity generation in Ireland will require the ETS to deliver an adequate carbon price signal. This is something which it has failed to do to recently.


Moneypoint, Ireland's only coal burning electricity generation plant, is owned and operated by the ESB. It contributes to Ireland's security of supply by diversifying the fuel mix, provides generation storage capacity and provides competitively priced electricity. However, while Moneypoint is an important element of our power generation mix, before it comes to the end of its operating life in its current configuration in 2025, the most suitable low carbon generation technology will have to be identified as committed to in the *Programme for a Partnership Government*. Key decisions on the future of Moneypoint will be taken before 2020.

PSO support for Bord na Móna's Edenderry peat-fired power station expired in December 2015. The Edenderry power station is now in receipt of support for biomass co-firing via REFIT 3 for up to 30% the size of the plant. In addition, Bord na Móna has stated that it intends to cease harvesting peat for electricity generation by 2030. The company has committed to replace large-scale peat production with alternative energy sources. This will contribute significantly to the decarbonisation of electricity and is in keeping with the Energy White Paper.

The PSOs for the ESB's West Offaly and Lough Ree peat power stations expire in 2019, aligning with Government policy to transition to a low carbon energy system. These two peat plants may, like Edenderry, also move to co-firing with biomass.

**Electricity use in Buildings and Transport**

There is an increasing trend of fuel switching in the building and transport sectors, as electrical technologies become more cost-efficient. Replacements for fossil fuel heating technologies, such as heat pumps, are readily available and declining in cost. In transport, electric vehicles will replace many passenger car models. The shift to electricity in buildings and transport will cause uncertainty in the amount of electricity needed to meet the country's needs, as electricity use rises through new end-uses and reduces through improved energy efficiency. It also has the consequence of reducing emissions in the non-traded sectors, as the additional emissions will fall with electricity in the EU ETS.

**Behavioural Change**

Behavioural change is at the heart of increasing our energy efficiency. In all future energy scenarios, consuming less electricity reduces the need for additional infrastructure with its associated social and economic costs. The Energy White Paper sets out a range of energy efficiency commitments, including the introduction of a sustained information campaign and advisory supports for consumers to address the barriers to consumer decision-making on energy efficiency. Improving energy efficiency is already paying dividends. In the short-term, focussed sustainable energy education and publicity will support behavioural change and underpin renewable electricity policies. Chapter 3 addresses energy efficiency.
2.4 Mitigating Measures in Place

Ireland has a range of policy measures in place aimed at decarbonising the electricity system.

Measures RE1, RE2, RE3 and RE4 – Support Schemes for Renewable Electricity

Internationally, support schemes are widely used to incentivise the growth of renewable electricity technologies, recognising the necessity to finance the cost differential between fossil and renewable energy resources. An Alternative Energy Requirement (AER)(RE4) scheme and three Renewable Energy Feed-in Tariff (REFIT) schemes, namely REFIT 1 (RE1), REFIT 2 (RE2) and REFIT 3 (RE3), have been in place in Ireland for a number of years. The cost of the support schemes is recovered directly from electricity consumers via the annually set PSO levy, payable by all electricity consumers.

The AER scheme was launched by the then Department of Transport, Energy and Communications in 1996 and was the first step towards a market support for wind energy as part of the Department’s programme to promote the generation of electricity from renewable resources. The programme involved the tendering for contracts of certain fixed amounts of capacity, by potential renewable energy generators. The AER will remain in place until 2021, resulting in estimated cumulative GHG emissions reductions of 6.51 MtCO$_{2eq}$ over the period 2016 to 2030.

The REFIT schemes effectively provide a floor price for renewable electricity, guaranteeing a minimum return to investors in the various technologies. Different rates are set for different technologies and successful applicants must complete the development of their projects within a specified time period. REFIT 1, REFIT 2 and REFIT 3 will remain in place until 2027, 2032, and 2030 respectively, and is estimated to result in combined cumulative GHG emissions reductions of 59.09 MtCO$_{2eq}$ over the period 2016 to 2030.

The support schemes aim to encourage, in particular, onshore wind, hydro and biomass technologies. It is envisaged that the relevant generation units will remain in operation post the ending of the support payments, and continue to contribute to the transition to a low carbon electricity system.

Measure RE5 – Support for Ocean Research, Development and Demonstration

The OREDP provides for Exchequer support for ocean energy test sites and prototype development. With regard to the latter, the SEAI manages the Prototype Development Fund on behalf of DCCAE. The main focus of the fund is on stimulating industry-led projects for the development and deployment of ocean energy devices and systems. Ireland is also actively contributing to the development of a programme of EU and international collaboration in offshore renewable energy, specifically in respect of the difficult early stage of ocean energy development. The technology is not expected to reach commercial scale until the late 2020s. This collaboration offers the opportunity to access EU and other non-Exchequer funding. Noting the technology maturation timeline, no estimates of cumulative GHG emissions reductions over the period 2016 to 2030 are provided.
2.5 Mitigating Measures under Consideration

In designing new measures, security of supply, social acceptability, cost-effectiveness and technical feasibility are key considerations.

**Measure RE6 – Renewable Electricity Support Scheme**

The quantum of new renewable generation required to come on stream by 2030 has yet to be determined and will be materially influenced by decisions at EU level regarding the Emissions Trading Scheme and renewables trajectories. It has already been noted that the decarbonisation of large scale electric power generation provides options to decarbonise sectors such as heating and transport through electrification. A new PSO-funded Renewable Electricity Support Scheme is currently being designed. Key drivers of the cost of the new scheme will be its design, the technologies supported, and the overall quantum of additional renewable generation it seeks to add to the grid enhancing the role of communities. Clarity on the scheme, which will be subject to Government and EU State Aid approval, is expected in 2017.

**Measures RE7 and RE8 – Further electricity interconnection and future of Moneypoint**

The decision-making processes in regard to further electricity interconnection (RE7) and optimal future low carbon technical solutions for Moneypoint (RE8) and the peat-fired generation stations are less advanced and are likely to impact on GHG emissions reductions in the post-2020 period. Robust economic and other analysis of options will inform and underpin decision-making. In the absence of such decisions it is not possible to estimate cumulative GHG emissions reductions over the period out to 2030.

2.6 Overview of Costs and Emissions Reduction Potential

The tables below set out a brief overview of measures in place and under consideration by DCCAE. Several studies have attempted to address the question of the impact of support schemes on the electricity system costs in Ireland. The main analysis undertaken to date on the costs of renewable electricity is a 2015 study (unpublished) involving the SEAI, Eirgrid, the CER and the Department. The study examined costs and savings within the electricity system arising from additional renewable electricity deployment to 2020.

Any update of existing analysis presents a number of challenges to making a credible assessment of the net economic impacts of renewable electricity support measures. The only methodology which is fit for purpose for addressing this question would involve running multiple scenarios in PLEXOS (proprietary electricity modelling software). Such a study would take more than a year to complete. Since none of the previously conducted studies applied the same underlying fossil fuel price assumptions as those which have been used elsewhere in the NMP analysis, it is not possible to use existing analysis to understand the impact of the AER & REFIT. The task would also require an assessment of the differentiated costs of each individual support scheme. Disaggregating the impacts of different technologies under the various schemes is a complex task, requiring a baseline and multiple policy scenarios to be established running from 1999 onwards. A robust study into the impacts of renewable electricity supports on costs would also require the expert input of multiple stakeholders including CER and Eirgrid.
In summary, taking account of the above and the absence of a comprehensive study to date, projecting PSO costs into the future is extremely challenging. Any attempt to provide an estimate of costs without factoring in the elements above ignores the complexity of the issues involved and would not fully capture the net economic impacts of these supports. The completion of such an update has not been possible in the context of the NMP timeline.
### Table 2.2 Decarbonising Electricity Generation – Overview of Costs and Emissions Reduction Potential – Mitigating Measures in Place

<table>
<thead>
<tr>
<th>Classification of Measure</th>
<th>Exchequer Expenditure (€)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Direct Spend</td>
</tr>
<tr>
<td><strong>Reference</strong></td>
<td><strong>Title</strong></td>
</tr>
<tr>
<td>RE 1</td>
<td>Renewable Energy Feed-in-Tariff Scheme (REFIT 1)</td>
</tr>
<tr>
<td>RE 2</td>
<td>Renewable Energy Feed-in-Tariff Scheme (REFIT 2)</td>
</tr>
<tr>
<td>RE 3</td>
<td>Renewable Energy Feed-in-Tariff Scheme 3 (REFIT3)</td>
</tr>
<tr>
<td>RE 4</td>
<td>Alternative Energy Requirement (AER) Scheme</td>
</tr>
<tr>
<td>RE 5</td>
<td>Prototype Development Fund</td>
</tr>
</tbody>
</table>

* Several studies have attempted to address the question of the impact of support schemes on the electricity system costs in Ireland. An update on existing analysis using the harmonised macroeconomic assumptions applied to the assessment of other sectors would be required to take account of oil and gas prices, and to align with the assumptions underpinning the analysis in other sectors. The completion of such an update has not been possible in the context of the NMP timeline.
<table>
<thead>
<tr>
<th>Reference</th>
<th>Title</th>
<th>Type</th>
<th>Objective of measure</th>
<th>Exchequer Expenditure (€)</th>
<th>Exchequer Receipts (€)</th>
<th>NPV 2017-2020 (based on economic CBA)</th>
<th>NPV 2017-2030 (based on economic CBA)</th>
<th>Marginal cost per tonne of carbon abated (€) (as per MACC)</th>
<th>Cumulative GHG emissions reduction 2017-2020 (ktCO$_2$e)</th>
<th>Cumulative GHG emissions reduction 2017-2030 (ktCO$_2$e)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RE 1</td>
<td>In Place Renewable Energy Feed-in-Tariff Scheme (REFIT 1)</td>
<td>Support Scheme</td>
<td>To support investment in the development of renewable electricity generation and contribute to 2020 renewable electricity generation targets.</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
<td>Unknown</td>
<td>5,670 ktCO$_2$e</td>
<td>19,710 ktCO$_2$e</td>
</tr>
<tr>
<td>RE 2</td>
<td>In Place Renewable Energy Feed-in-Tariff Scheme (REFIT 2)</td>
<td>Support Scheme</td>
<td>To support investment in the development of renewable electricity generation and contribute to 2020 renewable electricity generation targets.</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
<td>Unknown</td>
<td>7,890 ktCO$_2$e</td>
<td>27,390 ktCO$_2$e</td>
</tr>
<tr>
<td>RE 3</td>
<td>In Place Renewable Energy Feed-in-Tariff Scheme 3 (REFIT3)</td>
<td>Support Scheme</td>
<td>To support investment in the development of renewable electricity generation and contribute to 2020 renewable electricity generation targets.</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
<td>Unknown</td>
<td>2,310 ktCO$_2$e</td>
<td>8,000 ktCO$_2$e</td>
</tr>
<tr>
<td>RE 4</td>
<td>In Place Alternative Energy Requirement (AER) Scheme</td>
<td>Support Scheme</td>
<td>To support investment in the development of renewable electricity generation and contribute to 2020 renewable electricity generation targets.</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
<td>Unknown</td>
<td>1,760 ktCO$_2$e</td>
<td>6,070 ktCO$_2$e</td>
</tr>
<tr>
<td>RE 5</td>
<td>In Place Prototype Development Fund Research and Demonstration</td>
<td>Support Scheme</td>
<td>To support investment in the development of offshore wave and tidal energy devices up to commercial stage, leading to deployment at offshore generation sites and ultimately contributing to renewable electricity generation from late 2020s.</td>
<td>Estimated €18.0m up to and including, 2020.</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
<td>Unknown</td>
<td>Nil</td>
<td>Unknown. Technology is not expected to reach commercial scale until the late 2020s.</td>
</tr>
</tbody>
</table>

*Several studies have attempted to address the question of the impact of support schemes on the electricity system costs in Ireland. An update on existing analysis using the harmonised macroeconomic assumptions applied to the assessment of other sectors would be required to take account of oil and gas prices, and to align with the assumptions underpinning the analysis in other sectors. The completion of such an update has not been possible in the context of the NMP timeline.
### Table 2.3 Decarbonising Electricity Generation – Overview of Costs and Emissions Reduction Potential – Mitigating Measures under Consideration

<table>
<thead>
<tr>
<th>Classification of Measure</th>
<th>Reference</th>
<th>Title</th>
<th>Type</th>
<th>Objective of measure</th>
<th>Exchequer Expenditure (€)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RE 6</td>
<td>Renewable Electricity Support Scheme (RESS)</td>
<td>Support Scheme</td>
<td>To support investment in the development of renewable electricity generation and contribute to 2020 renewable electricity generation targets.</td>
<td>Nil</td>
</tr>
<tr>
<td></td>
<td>RE 7</td>
<td>Increased electricity interconnection</td>
<td>Economic Instrument – direct investment</td>
<td>To increase security of electricity supply and facilitate increased levels of variable renewable electricity on the system.</td>
<td>Unknown</td>
</tr>
<tr>
<td></td>
<td>RE 8</td>
<td>Future role of coal in power generation</td>
<td>Economic Instrument – direct investment</td>
<td>To arrive at decisions on optimal future low carbon technical solutions for Moneypoint generation plant.</td>
<td>Unknown</td>
</tr>
</tbody>
</table>
## Chapter 2 Decarbonising Electricity Generation

### Table 2.3 Decarbonising Electricity Generation – Overview of Costs and Emissions Reduction Potential – Mitigating Measures under Consideration

<table>
<thead>
<tr>
<th>Classification of Measure</th>
<th>Objective of measure</th>
<th>Exchequer Expenditure (€)</th>
<th>Exchequer Receipts (€)</th>
<th>NPV 2017-2020 (based on economic CBA)</th>
<th>Marginal cost per tonne of carbon abated (€) (as per MACC)</th>
<th>Cumulative GHG emissions reduction 2017-2020 (ktCO₂e)</th>
<th>Cumulative GHG emissions reduction 2017-2030 (ktCO₂e)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RE 6</td>
<td>Under Development</td>
<td>Nil</td>
<td>Nil</td>
<td>Unknown as the scheme is not yet finalised.</td>
<td>Unknown as the scheme is not yet finalised.</td>
<td>Unknown as the scheme is not yet finalised.</td>
<td>Unknown as the scheme is not yet finalised.</td>
</tr>
<tr>
<td>RE 7</td>
<td>Increased electricity interconnection</td>
<td>Unknown</td>
<td>Unknown</td>
<td>Unknown</td>
<td>Unknown</td>
<td>Unknown</td>
<td>Unknown</td>
</tr>
<tr>
<td>RE 8</td>
<td>Future role of coal in power generation</td>
<td>Economic Instrument – direct investment</td>
<td>Unknown</td>
<td>Unknown</td>
<td>Unknown</td>
<td>Unknown</td>
<td>Unknown</td>
</tr>
</tbody>
</table>

Unknown as the scheme is not yet finalised.
3 Energy Efficiency in the Built Environment

3.1 Introduction

Improving energy efficiency is central to our transition to a low carbon economy. This is because using our energy more efficiently is the most cost-effective and accessible way to tackle climate change and, ultimately, decarbonise our built environment. Action on energy efficiency also reduces the CO₂ emissions connected with our energy use. We also need to change the fuels we use for heating, moving increasingly to a combination of renewable fuels and electrification of heat. Currently, Ireland relies on high-emitting, imported fossil fuels to meet over 88% of our energy needs at an annual cost of around €4.6 billion. By 2050 we need to reduce this reliance on fossil fuels very considerably. As stated previously, the Energy White Paper sets out a vision of a low carbon energy system which envisages GHG emissions reductions in the range of 80% to 95% compared to 1990 levels by 2050.

To achieve this, our energy system has to fundamentally change, both in terms of where our energy comes from and how we use it – this is why energy efficiency is important. If we use less energy it makes it easier to replace our fossil fuels with renewable energy. If we use our energy more flexibly it makes it easier to integrate different types of renewable energy into our energy system.

A key priority of EU energy policy since 2008 has been how to realise the potential of energy efficiency for a cost-effective transition to a sustainable, de-carbonised, European energy system. It was in response to the emerging international policy consensus on the importance of energy efficiency that the Government decided in 2009 to set a target for Ireland to improve its energy efficiency by 20% by 2020, meaning that energy savings of 31,950 GWh must be made. (It should be noted that 4,000 GWh of savings are forecast to come from Transport). Measures to achieve this target are set out in Ireland’s National Energy Efficiency Action Plan (NEEAP)17. A revised NEEAP is being prepared in parallel with the development of the sectoral mitigation measures for the Built Environment to be included in the NMP. Based on end 2015 data, SEAI has calculated that implementation of our NEEAP has resulted in energy savings of 19,204 GWh or a 12% improvement.

In 2009, it was also decided that the public sector should provide leadership on energy efficiency for the whole of our economy and society. This is why the public sector was given a more challenging target of a 33% energy efficiency improvement. SEAI monitor the progress to this target of over 300 public sector bodies and 3,700 schools. The SEAI Annual Report 2016 on Public Sector Energy Efficiency Performance18, shows that (based on end 2015 figures), energy efficiency in the public sector has improved by 21%.

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While Ireland’s 20% energy efficiency target is not legally binding, it is critical to our progress towards our statutory EU 2020 targets to reduce CO$_2$ emissions by 20% and meet 16% of our energy demand from renewable sources. Because our renewables target is a proportion of our overall energy demand, the less energy we use/the more energy efficient we are, the easier it makes it to meet that renewable energy target. Falling short of our national energy efficiency target by 5 percentage points could add as much as two percentage points to the effort we need to make to meet our renewable energy target. This is why, where additional Exchequer funding is available, its allocation towards energy efficiency measures should allow us to maintain, and increase, our efforts to address what, on a business as usual basis, would be a shortfall on our energy efficiency target in 2020. The additional funds allocated for 2017 will reduce that shortfall and build capacity to absorb more investment in following years, should that become available.

Looking beyond 2020 to the level of energy efficiency to be achieved by 2030, the European Commission has proposed an EU wide energy efficiency target of 30%. This is currently under negotiation and the public have the opportunity to give their views on the Commission’s proposal through a public consultation open on this link http://www.dccae.gov.ie/energy/en-ie/Pages/Consultation/Consultation-on-Clean-Energy-Package.aspx. The energy savings Ireland will commit to make between 2021 and 2030 will be established through the ongoing development of options as part of the NMP development process, and also through the development of the National Energy and Climate Plan to be prepared by each EU Member State for the post-2020 period. A first draft of the EU plan is required by quarter one 2018. Research by the SEAI indicates that there is technical potential for energy savings in the Built Environment of 16,000 GWh in the 2021 to 2030 period. The question is, with significant in-roads having been made into lower cost measures, how much of the technical potential will it be economic to realise. That is why the NMP development process is so important for the decisions we need to make on how we renovate, design, construct and use our buildings.

### 3.2 Emissions Profile

According to GHG emission projections produced by the EPA (see Table 3.1 below), the Built Environment will account for 17% of total national non-ETS emissions in 2020, under modelled Scenario 1, and emit just under 8 Mt CO$_2$ eq in 2020 out of a total of 45 Mt CO$_2$ eq. In modelled Scenario 2, emissions from the Built Environment fall to 6.4 Mt CO$_2$ eq out of a total of 42.5 Mt CO$_2$ eq. In both scenarios, emissions levels would be contained, but the level of reduction needed to place the Built Environment on a low carbon trajectory would not be achieved.
Table 3.1 Projected emissions from the Built Environment to 2020

<table>
<thead>
<tr>
<th>Sector</th>
<th>Mt CO₂ eq 2020</th>
<th>Mt CO₂ eq 2030</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Scenario 1</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Commercial/Institutional</td>
<td>2.1</td>
<td>2.2</td>
</tr>
<tr>
<td>Residential</td>
<td>5.8</td>
<td>5.3</td>
</tr>
<tr>
<td>Total Built Environment</td>
<td>7.9</td>
<td>7.5</td>
</tr>
<tr>
<td>Total non-ETS</td>
<td>45.0</td>
<td>45.6</td>
</tr>
<tr>
<td>Built Environment as % of non-ETS emissions</td>
<td>17%</td>
<td>16%</td>
</tr>
<tr>
<td><strong>Scenario 2</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Commercial/Institutional</td>
<td>1.4</td>
<td>1.3</td>
</tr>
<tr>
<td>Residential</td>
<td>5.0</td>
<td>4.0</td>
</tr>
<tr>
<td>Total Built Environment</td>
<td>6.4</td>
<td>5.3</td>
</tr>
<tr>
<td>Total non-ETS</td>
<td>42.5</td>
<td>42.4</td>
</tr>
<tr>
<td>Built Environment as % of non-ETS Emissions</td>
<td>15%</td>
<td>12%</td>
</tr>
</tbody>
</table>

Ultimately, carbon mitigation in the Built Environment will require a combination of energy efficiency and decarbonisation of heat i.e. that the fuel sources for heating move from fossil (typically oil or gas) to a low carbon option such as renewable or electric heat. Therefore, the first course of action is to renovate a building so that it loses as little heat as possible, before fuel switching. If the fabric of the building has already improved, these less energy intensive heating solutions will still produce the desired level of comfort. In summary, the key aspects relating to the built environment are as follows:

1. **Energy management**: understand existing energy use – how and when energy is being used
2. **Energy efficiency**: undertake energy efficiency improvements to reduce usage and make your demand for energy more flexible
3. **Fuel switching**: meet this reduced energy use with less energy intensive/low carbon heating solutions

Options for renewable heating include biomass and biogas from waste streams and from energy crops, solar thermal and geothermal energy. The planned Renewable Heat Incentive scheme will provide a key policy support measure for this development.
Through electrification of heat, there is a key link between the sectoral mitigation measures for the Built Environment and those for Electricity Generation as the electrification of heat is one of the main options for decarbonisation of heat, albeit this is dependent on the rate and level of decarbonisation of the electricity generation system.

### 3.3 Opportunities and Challenges

The focus on energy efficiency in Ireland, as set out in the *Energy White Paper*, reflects the strong international consensus that now exists regarding the critical importance of energy efficiency for effective action on climate change. The International Energy Agency (IEA) recommends that governments treat energy efficiency as the ‘first fuel’ in their energy mix on the basis that the most cost-effective energy is the energy we do not use. IEA analysis demonstrates that energy efficiency has the potential to support economic growth, enhance social development, advance environmental sustainability, ensure energy system security and help build wealth.

While Ireland has made real progress on energy efficiency, it has come from lower cost, more accessible measures such as attic insulation and energy conservation campaigns. Tackling these easier, cheaper measures first is a sensible approach and it has done a great deal to raise awareness of what energy efficiency is about and the benefits it can bring. However, we are now moving into a new phase where we need to achieve larger amounts of more durable energy savings from larger scale projects, in particular deep renovation of buildings and more sustainable new build. The greatest opportunity to reduce lifecycle energy and carbon is at the early design stages of new investments. Up to 95% of the lifespan cost is already committed at the end of the design process. Case study projects have demonstrated that savings available can range up to 50% improvement from a baseline design.

Energy efficiency is achieved as a result of reduced or more flexible demand from different sectors of the economy and society, rather than centrally planned works or incentivising a small number of market players to act. This means that the success of policy on energy efficiency, and the operational measures put in place to give effect to it, is dependent on a great many individual people making their own decision to make their homes or places of work more energy efficient. So, while it is very important that the measures in place are technically robust, how they are communicated to those people whose decision to act policy makers depend on, is just as important. Based on the experience gained and data gathered in the last 8 years or so, a great deal has been learned about how to encourage the uptake of energy efficiency, i.e. the opportunity for energy efficiency, and what discourages people from acting, i.e. the challenges.

The *Capital Plan Building on Recovery: Infrastructure and Capital Investment 2016-2021* provides for investment to improve energy efficiency in the built environment which will result in reduced GHG emissions – including supports for domestic energy improvements, smart metering, the upgrade of public building stock to more energy efficient levels, improved energy efficiency of school buildings as well as support for the Renewable Heat Incentive. The mid-term review of the Capital Plan to be conducted in 2017 will provide an opportunity to consider the potential for further contribution of Capital Plan investment to the achievement of NMP and energy efficiency objectives. Based on 2017 allocations, a business as usual scenario would see €330m allocated to energy efficiency measures in the period 2017 to 2020.

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The Residential Sector

In the residential sector, reducing energy bills has been a key ‘selling point’ for energy efficiency and has certainly been a strong motivating factor for the over 300,000 householders that have undertaken energy efficiency upgrades in Ireland since 2009. However, it is increasingly apparent that improved comfort and ease of energy management are also factors that people value and they consistently figure in how people rate their satisfaction with the energy efficiency upgrades they have received. Ease of access to grant funding through the SEAI’s Better Energy Programme has also proven to be a success factor. Building on this experience, there is a case for increasing the advisory support available to householders in choosing the measures they should undertake, the building works involved, and how they then manage the energy in their newly energy efficient homes. This knowledge is feeding into ongoing development of the Better Energy Programme and Building Energy Rating (BER) process. It is also why DCCAE, through SEAI, is starting a Deep Retrofit Pilot scheme in 2017.

There is also clear evidence that living in a cold damp house is linked to poor health, in particular chronic respiratory conditions. The risk of this increases significantly for those living in, or at risk of, energy poverty. There is an invaluable opportunity to address energy poverty through energy efficiency. Not only can reducing energy bills for those least able to pay, a way to address general deprivation, increasing comfort can result in better health outcomes and improved social inclusion. That is why, in 2016, DCCAE embarked on a joint policy initiative with the Department of Health to establish the Warmth & Wellbeing Pilot Scheme. Delivered by the SEAI and Health Service Executive (HSE), it is bringing comprehensive energy upgrades to the homes of older people and children with certain clinical conditions. A research project will run in parallel over the three years of the pilot to establish the impacts of these measures on the health of recipients and if there is a reduction in their need for health services. Further actions on energy poverty are being undertaken through the implementation of the National Strategy to Combat Energy Poverty, including addressing poor energy efficiency standards in rental accommodation.

Looking beyond 2020, a key challenge in the residential sector will be financing and finding sources of finance other than the Exchequer grant aid. Ultimately, this will mean activating private financing at a sufficiently attractive interest rate. For energy efficiency upgrades costing over c. €3,000, which would typically be funded by a Better Energy Grant and householder savings, and less than an amount which would make a mortgage top-up attractive, the current interest rate of c. 10% is simply not low enough to encourage significant take up.

However, even an attractive interest rate won’t be the deciding factor. People need to be convinced of the case for energy efficiency and supported to act. This is why an important initiative with the additional funding made available for energy efficiency in 2017, is the establishment by the SEAI of a Behavioural Economics Unit to complement their on-going financing pilot schemes. These measures will also complement the Deep Retrofit Pilot scheme. Tackling the challenges of financing and advisory support will be key to placing the residential sector on an appropriate emissions reduction trajectory to 2050.
The Commercial Sector

Achieving emissions reductions through energy efficiency in the commercial sector is potentially one of the most cost-effective areas of action. Government does not provide large amounts of Exchequer funding capital works in this sector in the same way as in the residential sector, rather the focus is on enabling actions and technical support. The Large Energy Users Network continues to be a very successful way for SEAI to engage with a significant part of commercial energy use and will continue to be a core measure.

SEAI will build on the experience gained here to tap into the potential of the Small, Medium Enterprise (SME) sector. There is real energy saving potential here, particularly in relatively accessible areas such as lighting, heating and cooling. However, it is a sector that is by nature very diverse and for which energy costs tend not to be a critical issue. Communicating the case for energy efficiency effectively and making the right technical supports available will be necessary to meet the challenge here. This will be the focus of the SME element of SEAI’s industrial engagement programme.

The progressive implementation of the EU requirement under the Energy Efficiency Directive for businesses to carry out energy audits will provide an increasing regulatory drive for the commercial sector to improve energy efficiency. However, this regulatory requirement will not by itself produce energy savings. Rather they will come when businesses act on the results of their audits. Commitment to achieve certification of energy management and energy savings is the best way for businesses to ensure they are on the path to realising their energy efficiency potential and the cost savings it can produce. SEAI offers support to business to undertake certification of the efficient design and management of energy assets using the ISO 50001 and IS399 standards through the ExEED programme.

There is also an increasing concern in the business community with corporate social responsibility and climate action. Energy efficiency is becoming increasingly recognised as the first and most accessible step business can take to ‘go green’.

The Public Sector

The public sector shares many characteristics with the commercial sector in terms of the size and use of its built environment. There is a very important opportunity for the public sector to provide leadership to the wider economy on energy efficiency and, in doing so, contribute to public sector reform. To realise the energy efficiency potential of this sector a Public Sector Energy Efficiency Strategy was recently approved by Government and its implementation is now underway. The objectives of the Strategy are:

1. The public sector, maximising its own skills and experience, takes a national leadership role in deploying cost efficient energy efficiency projects and initiatives.

2. The delivery of this Strategy is a shared, whole-of-Government, effort where all Government Departments, and the bodies under their aegis, play their part in embedding structured energy management as part of their business delivery.

3. In the context of public sector reform, the public sector takes an action focused and results driven approach to sustainable and cost efficient energy management, thereby delivering better value for money and better services for citizens.

4. The public sector contributes to the development of a more sustainable energy system, a reduction in CO₂ emissions and a cleaner and healthier environment now and for future generations.

While a lot has been achieved in the public sector since 2010, achieving its target of improving energy efficiency by 33% by 2020 will require an increased level of effort and larger scale building renovation projects. To build on the existing supports for the public sector such as the SEAI’s Public Sector and the OPW’s Optimising Power@Work programmes, the Strategy introduces a number of other measures including:

- A new governance structure to ensure senior leadership on energy efficiency in the public sector
- A central project pipeline and enhanced project development assistance
- €3m for an initial pilot of deep renovation projects to central government buildings by the OPW in partnership with SEAI
- Clarity on the retention of savings achieved by public sector bodies from energy efficiency as part of their management of their administrative budgets

**Cross Sectoral and Community**

Using energy efficiency to address issues as diverse as deprivation or commercial energy costs is a clear example of how energy efficiency is not an energy only issue. It can and does support the achievement of objectives from health, to social inclusion, competitiveness and GHG emissions reduction. Therefore, there is huge opportunity in combining the efforts of different groups and bringing them together to act and, in doing so, to support each other. This is where the Better Energy Communities scheme, which supports joint projects by business, public sector and community partners, is making a real contribution, not just to energy efficiency, but to increasing public understanding of the low carbon transition.

Conserving their energy is the first step citizens can take to make their contribution to climate action and realise benefits for their families and businesses. But we also need to build the capacity of communities to participate in such initiatives. This is why the SEAI also established the Sustainable Energy Communities scheme, which works with groups from all around Ireland to build their technical and project management skills. The starting point is energy efficiency, but the next step can be renewable energy generation within communities, which forms another link between the sectoral mitigation measures for the Built Environment and those for Electricity Generation.

Developing understanding of energy efficiency across the economy, providing energy efficiency upgrades to homes, public bodies and businesses, and providing technical and project management support to community groups, are all elements of the Energy Efficiency Obligation Scheme, which is a critical part of how we are making energy savings to 2020. The targets for the energy companies obligated by the scheme to deliver energy efficiency measures to homes (including those experiencing, or at risk of, energy poverty) and businesses were recently increased for the period to 2020. It is envisaged that this scheme will continue to play a key role in our energy efficiency strategy to 2030.
3.4 Mitigating Measures in Place

Ireland’s NEEAP provides a comprehensive overview of mitigating measures to improve energy efficiency and reduce emissions across all sectors including the built environment. An updated NEEAP and a new Long Term Renovation Strategy (for the Built Environment) are in preparation as required by EU legislation.

There are three key opportunities where it is possible to influence the use of energy in the built environment:

- **Design**: when new buildings and facilities are being planned and designed and when existing buildings, and the energy using processes carried out within them, are being re-designed
- **Acquisition**: when equipment and facilities are being bought, upgraded or leased
- **Use**: when people use energy as part of their daily lives in the places they live and work

The Mitigating Measures currently in place, and those being introduced in 2017, focus in various ways on each of these areas. While some of these measures have been in place for some years e.g. the Better Energy Programme has been operating since 2009, other measures are only now beginning in the form of pilots. This is because we are at an important stage in developing our energy efficiency strategy. We have learned a lot from the measures in place. This has allowed us to identify the opportunities and challenges. Now we need to understand the best way to develop our measures to meet the needs of energy users and help them make the decision to act on energy efficiency. The outcomes of these pilot schemes such as the Warmth & Wellbeing, Deep Renovation, ExEED and the Office of Public Works (OPW)/SEAI public sector renovation projects will inform the design of measures to be implemented in the post-2020 period.

### Fiscal Supports

**Better Energy Programme**

The Better Energy grant programme is administered by the SEAI on behalf of DCCAE and consists of the Better Energy Homes (BEH) scheme, Better Energy Warmer Homes (BEWH) scheme and Better Energy Communities (BEC) scheme.

**Alternative Financing (an element of the Better Energy Programme)**

SEAI offers small scale grants and supports to trial innovative financing options such as salary sacrifice for residential energy efficiency upgrades.

**Measure BE 1 – Better Energy Homes**

The BEH scheme provides grant aid to private homeowners who wish to improve the energy performance of their home. Fixed grants are provided towards the cost of a range of measures including attic insulation, wall insulation, heating systems upgrades, solar thermal panels and accompanying BER.

**Measure BE 2 – Better Energy Warmer Homes**

The BEWH scheme funds energy efficiency improvements in the homes of the elderly and vulnerable, making the homes more comfortable, healthier and more cost-effective to run.
Measure BE 3 – Rental sector – Housing Assistance Package
In 2017, a pilot scheme to encourage landlords participating in the Housing Assistance Package (HAP) to avail of the Better Energy Programme will get underway to incentivise energy standard improvements in the rental sector.

Measure BE 4 – Better Energy Communities
The BEC scheme aims to encourage community based partnerships to improve the thermal and electrical efficiency of the building stock and energy poor homes and facilities, encouraging the implementation of deeper and more technically and economically challenging measures. These partnerships can be between the public and private sectors, domestic and non-domestic sectors, commercial and not-for-profit organisations and energy suppliers. The community and business supports leverage considerable additional private investment.

Measure BE 5 – Warmth & Wellbeing Pilot Scheme
This three-year pilot is providing energy efficiency improvements to the homes of older people and children suffering from chronic respiratory conditions. This is a joint policy initiative between DCCAE and the Department of Health and delivered by the SEAI and the HSE.

Measure BE 6 – Deep Retrofit Pilot
This pilot scheme will be launched by SEAI in 2017 to establish how best to support deeper levels of renovation in the residential sector, with a view to gaining practical experience of how to develop a residential energy efficiency offering post-2020.

Measure BE 7 – Social Housing upgrades
Energy efficiency upgrades are undertaken by local authorities to social housing stock funded by the Department of Housing, Planning Community & Local Government (D/HPCLG).

Measure BE 8 – Green procurement and Accelerated Capital Allowances
Accelerated capital allowances for energy efficient equipment is supporting the reduction of energy use in the workplace and the awareness of energy efficiency standards in appliances and products.

Other Financial Supports

Measure BE 9 – The Energy Efficiency Fund
In 2014, the Government invested €35m in a commercial fund along with a number of private investors. The fund has raised over €70m in investment and has a project pipeline of commercial and public projects.
Regulatory Measures

Measure BE 10 – Building regulations

Part L – Conservation of Fuel and Energy in Buildings, one of twelve parts comprising the Second Schedule of the Building Regulations, is in place to limit the energy use and carbon dioxide emissions from a building as far as is practicable and requires an energy performance and carbon dioxide emissions performance that is 60% better than the 2005 Part L requirements. This is recognised as an advanced energy performance requirement for buildings.

The Energy Performance of Buildings Directive requires that all new buildings (public and private) are Nearly Zero Energy Buildings (NZEB) by 2020. It also requires that new buildings owned and occupied by public authorities are NZEB after 2018.

Part L of the Building Regulations for Dwellings sets the NZEB performance for buildings completed after the 31st Dec 2020, which represents a 70% improvement in energy performance when compared with the 2005 Part L requirements.

Part L of the Building Regulations for non-residential buildings is currently under review in order to establish the NZEB performance requirement and this will be published by mid-2017. As part of this review it is also intended to extend the requirement to achieve a cost optimal energy performance at a whole of building level when a major renovation is being carried out in respect of a building.

The requirement to achieve a cost optimal energy performance during major renovations will be extended to include dwellings during the next review of Part L of the Building Regulations for Dwellings which is scheduled to take place during 2018. However in the interim and in order to assist the construction industry in preparation for NZEB, a numerical indicator for the energy performance requirement of NZEB dwellings was inserted into the revised Technical Guidance Document L (2011) in respect of Dwellings in early 2017.

Measure BE 11 – Building Energy Rating (BER) Certificates

The requirements around the BER have proved very effective in raising awareness of energy efficiency. More consumer-friendly BER documentation will be introduced in 2017 to better guide householders in understanding the results of their BER and acting on them, by including information on measures and likely costs. The new BER documentation will also feature the emissions levels associated with the dwelling more prominently to help raise awareness of these emissions and how they could be managed.

Measure BE 12 – Energy audits for large energy users

As part of the implementation of the EU Energy Efficiency Directive, in 2015 a requirement was placed on large energy users in the commercial and public sectors to undertake energy audits. This mandatory requirement is supported by advisory measures.

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21 The Directive defines a NZEB as a building that has a very high energy performance and that the nearly zero or very low amount of energy required should be covered to a very significant extent by energy from renewable sources, including energy from renewable sources produced on-site or nearby. This definition was incorporated in the Building Regulations earlier this year by way of Statutory Instrument (S.I. No. 4 of 2017 Building Regulations (Amendment) Regulations).

22 A major renovation occurs where the renovation involves works being carried out to more than 25% of the surface envelope of the building.
Measure BE 13 – Energy Efficiency Obligation Scheme
Since 2014, as part of the implementation of the EU Energy Efficiency Directive, energy suppliers above a certain threshold are obligated to deliver annual energy savings to consumers across the residential and commercial sectors. The targets for obligated parties have been increased for the period 2017 to 2020 and the threshold for obligation lowered. Penalties are in place for non-compliance.

Technical support
Measure BE 14 – Large Industry Energy Network
This is a voluntary grouping of the largest commercial energy users, facilitated by the SEAI, where companies share knowledge and best practice on energy management and energy cost reduction.

Measure BE 15 – SME support
The SEAI provides advice and training for SMEs on energy management, particularly in areas such as lighting, heating and cooling.

Measure BE 16 – Qualibuild
This is an initiative run by the Green Building Council to develop the energy efficiency skills of the construction sector. Around 60 instructors and 200 construction workers have received training to date.

Measure BE 17 – Schools Technical Bureau
Energy efficiency activity adds real value to student experience, but present particular challenges to the educational sector. The SEAI and the Department of Education and Skills (DES) are building on their existing cooperation to establish this support to schools to understand and manage their energy use in coordination with the Department’s capital programme.

Measure BE 18 – Behavioural Economics Unit
To better understand how to overcome the barriers consumers face to taking action on energy efficiency, the SEAI is establishing a dedicated Behavioural Economics Unit in 2017, to provide input to policy development and coordinate with the use of this discipline across wider government policy formation.

Measure BE 19 – Support Network for Delivery of Public Sector Energy Efficiency Targets
The SEAI supports public sector bodies to achieve their 33% energy efficiency target. From 2017 these supports will be enhanced in support of the new Public Sector Energy Efficiency Strategy to include assistance in establishing a pipeline of large-scale projects.
3.5 Mitigating Measures under Consideration

**Measure BE 20 – Renewable Heat Incentive**
A Renewable Heat Incentive (RHI) is in development as part of the action to meet our 2020 renewable heat target. The public consultation was launched on 26 January 2017.

**Measure BE 21 – Smart metering**
A Cost Benefit Analysis (CBA) on the roll out of a national programme is due at the end of 2017.

**Measure BE 22 – Minimal thermal standards in rental properties**
The National Strategy to Combat Energy Poverty has highlighted the correlation between energy poverty and the low levels of energy efficiency in rental accommodation. It also identified the objective, post-2020, of introducing regulatory measures to preclude the rental of the lowest BER rated properties in the interests of improving living standards and reducing energy costs for those at risk of energy poverty. A consultation on this issue will be undertaken by DCCAE in 2017.

**Measure BE 23 – Voluntary Housing Association upgrades**
The potential of a pilot scheme to assist in addressing energy poverty by providing grant aid for energy efficiency upgrades through a cluster approach has been identified.

3.6 Overview of Costs and Emissions Reduction Potential

The tables below set out a brief overview of measures in place and under consideration that have been modelled as part of the ongoing cross-Departmental work on evaluating the emissions reduction potential and costs of a range of climate change mitigation measures. The analytical outputs are based on a marginal abatement cost curve approach which assesses the impact of an abatement measure against a set baseline. Common assumptions have been applied for the three energy sectors in relation to key parameters such as the discount rate, fuel costs and shadow prices. The further expansion of existing programmes and schemes in the period post-2020, will require further analysis, which will include the results of the various pilot schemes now underway or beginning in 2017. The work of the Behavioural Economics Unit to be established by SEAI in 2017 will also be a key input to such analysis.
Table 3.2 Energy Efficiency in the Built Environment – Overview of Costs and Emissions Reduction Potential – Mitigating Measures in Place

<table>
<thead>
<tr>
<th>Classification of Measure</th>
<th>Objective of measure</th>
<th>Exchequer Expenditure (£)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Reference</strong></td>
<td><strong>Title</strong></td>
<td><strong>Direct Spend</strong></td>
</tr>
<tr>
<td>BE 1 In place</td>
<td>Better Energy Homes (BEH)</td>
<td>79.54m</td>
</tr>
<tr>
<td></td>
<td>Economic Instrument – Fiscal Measure</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The BEH scheme operated by SEAI is aimed at improving the energy efficiency of homes to reduce occupant’s energy consumption, costs and emissions. It provides grant aid to private homeowners to improve the energy performance of their home. Grants can be provided towards the cost of measures including attic and/or wall insulation, heating system upgrades, solar thermal panels and accompanying BER.</td>
<td></td>
</tr>
<tr>
<td>BE 2 In place</td>
<td>Better Energy Warmer Homes (BEWH)</td>
<td>86.48m</td>
</tr>
<tr>
<td></td>
<td>Economic Instrument – Fiscal Incentive</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The BEWH scheme improves the energy efficiency of the housing stock of those in energy poverty through the provision of funds for energy efficiency improvements to help reduce their energy consumption, costs and emissions. This makes the homes more comfortable, healthier and more cost-effective to run.</td>
<td></td>
</tr>
<tr>
<td>BE 3 Will be in place from 2017</td>
<td>Housing Assistance Package for Landlords</td>
<td>N/A – Spend and impacts reflected in other BEP measures</td>
</tr>
<tr>
<td></td>
<td>Economic Instrument – Fiscal Incentive</td>
<td></td>
</tr>
<tr>
<td></td>
<td>This is a pilot scheme as part of the Better Energy Programme to encourage landlords participating in the Housing Assistance Package (HAP) to avail of the Better Energy Programme (BEP) to incentivise energy standard improvements in the rental sector.</td>
<td></td>
</tr>
<tr>
<td>BE 4 In place</td>
<td>Better Energy Communities (BEC)</td>
<td>85.76m</td>
</tr>
<tr>
<td></td>
<td>Economic Instrument – Fiscal Incentive</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The aim of this scheme is to improve the energy efficiency of clusters of buildings in community based settings and encourage implementation of deeper upgrade measures. The BEC scheme aims to encourage community based partnerships to improve the energy efficiency of clusters of buildings to reduce occupants’ energy consumption, costs and emissions. These partnerships can be between the public and private sectors, domestic and non-domestic sectors, commercial and not-for-profit organisations and energy suppliers.</td>
<td></td>
</tr>
<tr>
<td>BE 5 In place</td>
<td>Warmth and Wellbeing Pilot Scheme</td>
<td>32.4m</td>
</tr>
<tr>
<td></td>
<td>Economic Instrument – Fiscal Incentive and Research/Demonstration</td>
<td></td>
</tr>
<tr>
<td></td>
<td>A 3 year pilot providing energy efficiency improvements to the homes of older people and children suffering from chronic respiratory conditions relating to the thermal efficiency of their homes. This is a joint policy initiative between DCCAE and the Department of Health and delivered by the SEAI and the HSE. Research on the outcomes including reduction in need for healthcare will inform the understanding of the wider benefits of improving homes to improve energy efficiency.</td>
<td></td>
</tr>
</tbody>
</table>
### Chapter 3  Energy Efficiency in the Built Environment

<table>
<thead>
<tr>
<th>Exchequer Receipts (€)</th>
<th>NPV 2017-2020 (based on economic CBA)****</th>
<th>NPV 2017-2030 (based on economic CBA)****</th>
<th>Marginal cost per tonne of carbon abated (€)(as per MACC)</th>
<th>Cumulative GHG emissions reduction 2017-2020 (ktCO₂e)</th>
<th>Cumulative GHG emissions reduction 2017-2030 (ktCO₂e)</th>
</tr>
</thead>
<tbody>
<tr>
<td>N/A</td>
<td>Direct = -88m*</td>
<td>Direct = 23m</td>
<td>Direct** = -31 (Economic)</td>
<td>149</td>
<td>744</td>
</tr>
<tr>
<td></td>
<td>Direct Plus Indirect = -76m*</td>
<td>Direct Plus Indirect = 66m</td>
<td>Direct Plus Indirect = -89 (Economic)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N/A</td>
<td>Direct = -67m</td>
<td>Direct = -32m</td>
<td>Direct** = 135 (Economic)</td>
<td>47</td>
<td>235</td>
</tr>
<tr>
<td></td>
<td>Direct Plus Indirect = -61m</td>
<td>Direct Plus Indirect = -10m</td>
<td>Direct Plus Indirect = 41 (Economic)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N/A</td>
<td>Spend and impacts reflected in other BEP measures – especially BE 2</td>
<td>Spend and impacts reflected in other BEP measures</td>
<td>Spend and Impacts are reflected in other BEP measures</td>
<td>Spend and impacts reflected in other BEP measures</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N/A</td>
<td>Direct = -101m</td>
<td>Direct = 56m</td>
<td>Direct** = -61 (Economic)</td>
<td>184</td>
<td>922</td>
</tr>
<tr>
<td></td>
<td>Direct Plus Indirect = -85m</td>
<td>Direct Plus Indirect = 113m</td>
<td>Direct Plus Indirect = -122 (Economic)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N/A</td>
<td>Direct = -25m</td>
<td>Direct = -12m</td>
<td>Direct** = 132 (Economic)</td>
<td>18</td>
<td>89</td>
</tr>
<tr>
<td></td>
<td>Direct Plus Indirect = -23m</td>
<td>Direct Plus Indirect = -3m</td>
<td>Direct Plus Indirect = 38 (Economic)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Marginal cost per tonne of carbon abated (€) calculated using MACC.
** Marginal cost per tonne of carbon abated (€) calculated using MACC.
**** Economic conditions.
### Table 3.2 Energy Efficiency in the Built Environment – Overview of Costs and Emissions Reduction Potential – Mitigating Measures in Place (cont’d)

<table>
<thead>
<tr>
<th>Classification of Measure</th>
<th>Objective of measure</th>
<th>Exchequer Expenditure (€)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Reference</strong></td>
<td><strong>Title</strong></td>
<td><strong>Type</strong></td>
</tr>
<tr>
<td>BE 6</td>
<td>Deep Retrofit Pilot</td>
<td>Research – Demonstration (Pilot)</td>
</tr>
<tr>
<td>New from 2017</td>
<td>The aim of this pilot is to test approaches to achieving deep retrofit in the residential sector, to gain practical experience of how to develop a residential energy efficiency offering post-2020 to deliver the scale of impacts needed to achieve decarbonisation goals.</td>
<td></td>
</tr>
<tr>
<td>BE 7</td>
<td>Social Housing Upgrades (DHPCLG)</td>
<td>Capital Programme</td>
</tr>
<tr>
<td>In place</td>
<td>Local authorities are currently undertaking an ambitious programme of insulation retrofitting, with the support of the Department of Housing, Planning, Community &amp; Local Government (DHPCLG). The programme is being implemented in a number of phases: Phase 1 commenced in 2013 and is focused on providing attic/roof insulation and the less intrusive cavity wall insulation while Phase 2, which has commenced on a pilot basis, will focus on the external fabric upgrade of those social housing units with solid/hollow block wall construction.</td>
<td></td>
</tr>
<tr>
<td>BE 8</td>
<td>Green Procurement &amp; Accelerated Capital Allowance (‘Triple E’ List)</td>
<td>Economic Instrument – Fiscal Incentive</td>
</tr>
<tr>
<td>In place</td>
<td>To promote the use of qualifying energy efficient products, equipment and technologies, an accelerated capital allowances (ACA) scheme is in place for the purchase of energy efficient equipment in the workplace. Companies are offered a tax incentive to purchase highly energy efficient equipment thus helping to improve the energy efficiency of Irish companies and to contribute to emissions reductions.</td>
<td></td>
</tr>
<tr>
<td>BE 9</td>
<td>Energy Efficiency Fund</td>
<td>Economic Instrument – Fiscal Incentive</td>
</tr>
<tr>
<td>In place</td>
<td>This is a commercial fund of €70m in which Government have invested €35m. The objective is to support a pipeline of commercial and public projects. It has the capacity to leverage potential investment of €300m in energy efficiency.</td>
<td></td>
</tr>
<tr>
<td>BE 10-1</td>
<td>Nearly Zero Energy Buildings (NZEBr)</td>
<td>Regulation</td>
</tr>
<tr>
<td>At public consultation – to complete Oct. 2017</td>
<td>The aim of this measure is to introduce new Building Regulations for Buildings other than Dwellings to achieve a reduction in energy demand and carbon dioxide emissions in the order of 60% compared to 2005 levels.</td>
<td></td>
</tr>
</tbody>
</table>
### Chapter 3  Energy Efficiency in the Built Environment

#### Table 3.2  Energy Efficiency in the Built Environment – Overview of Costs and Emissions

<table>
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<tr>
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<th>NPV 2017-2030 (based on economic CBA)****</th>
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<th>Cumulative GHG emissions reduction 2017-2020 (kT CO₂)</th>
<th>Cumulative GHG emissions reduction 2017-2030 (kT CO₂)</th>
</tr>
</thead>
<tbody>
<tr>
<td>N/A</td>
<td>Direct* = -28m</td>
<td>Direct = -18m</td>
<td>Direct** = 256 (Economic) Direct Plus Indirect = 115 (Economic)</td>
<td>14</td>
<td>70</td>
</tr>
<tr>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
</tr>
<tr>
<td>N/AI</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
</tr>
<tr>
<td>N/A</td>
<td>This is a support measure – its impacts should mostly be reflected in other quantified measures.</td>
<td>This is a support measure – its impacts should mostly be reflected in other quantified measures.</td>
<td>This is a support measure – its impacts should mostly be reflected in other quantified measures.</td>
<td>This is a support measure – its impacts should mostly be reflected in other quantified measures.</td>
<td>This is a support measure – its impacts should mostly be reflected in other quantified measures.</td>
</tr>
<tr>
<td>N/A</td>
<td>N/A</td>
<td>TBD</td>
<td>TBD</td>
<td>N/A</td>
<td>This measure will provide a reduction in the order of 50% to 60% in carbon emissions from all new buildings other than dwellings completed after the 30th Dec 2020. This equates to 44.1 kg CO₂/ m²/yr for a typical office. Cumulative reduction TBD.</td>
</tr>
</tbody>
</table>

**Notes:**
- *: New measure.
- **: This measure will provide a reduction in the order of 50% to 60% in carbon emissions from all new buildings other than dwellings completed after the 31st Dec 2020. This equates to 44.1 kg CO₂/ m²/yr for a typical office. Cumulative reduction TBD.
Table 3.2 Energy Efficiency in the Built Environment – Overview of Costs and Emissions Reduction Potential – Mitigating Measures in Place (cont’d)

<table>
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<tr>
<th>Classification of Measure</th>
<th>Objective of measure</th>
<th>Exchequer Expenditure (€)</th>
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</thead>
<tbody>
<tr>
<td>Reference</td>
<td>Title</td>
<td>Type</td>
</tr>
<tr>
<td>BE 10–2</td>
<td>Nearly Zero Energy Dwellings (NZE)</td>
<td>Regulation</td>
</tr>
<tr>
<td>BE 10–3</td>
<td>Major Renovations Dwellings</td>
<td>Regulation</td>
</tr>
<tr>
<td>BE 10–4</td>
<td>Major Renovations Dwellings</td>
<td>Regulation</td>
</tr>
<tr>
<td>BE 11</td>
<td>Building Energy Rating (BER) Certificates</td>
<td>Regulatory Instrument</td>
</tr>
<tr>
<td>BE 12</td>
<td>Energy Audits for Large Energy Users</td>
<td>Regulatory Instrument</td>
</tr>
</tbody>
</table>
## Chapter 3  Energy Efficiency in the Built Environment

<table>
<thead>
<tr>
<th>Exchequer Receipts (€)</th>
<th>NPV 2017-2020 (based on economic CBA)****</th>
<th>NPV 2017-2030 (based on economic CBA)****</th>
<th>Marginal cost per tonne of carbon abated (€) (as per MACC)</th>
<th>Cumulative GHG emissions reduction 2017-2020 (kt CO₂e)</th>
<th>Cumulative GHG emissions reduction 2017-2030 (kt CO₂e)</th>
</tr>
</thead>
<tbody>
<tr>
<td>N/A</td>
<td>N/A</td>
<td>TBD</td>
<td>TBD</td>
<td>N/A</td>
<td>This measure will provide a reduction in the order of 70% in Carbon emissions from dwellings completed after the 31st Dec 2020. This equates to 91.35 kt CO₂e</td>
</tr>
<tr>
<td>N/A</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
<td>Currently under review. TBD</td>
</tr>
<tr>
<td>N/A</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
<td>Currently under review. TBD</td>
</tr>
<tr>
<td>N/A ‘operated by SEAI on a cost neutral basis’.</td>
<td>This is a support measure – its impacts are reflected in other quantified measures.</td>
<td>This is a support measure – its impacts are reflected in other quantified measures.</td>
<td>This is a support measure – its impacts are reflected in other quantified measures.</td>
<td>This is a support measure – its impacts are reflected in other quantified measures.</td>
<td>This is a support measure – its impacts are reflected in other quantified measures.</td>
</tr>
<tr>
<td>N/A</td>
<td>A support measure – impacts will be reflected in other quantified commercial and public sector measures i.e. BE 19 and BE 14.</td>
<td>A support measure – impacts will be reflected in other quantified commercial and public sector measures.</td>
<td>A support measure – impacts will be reflected in other quantified commercial and public sector measures.</td>
<td>A support measure – impacts will be reflected in other quantified commercial and public sector measures.</td>
<td>A support measure – impacts will be reflected in other quantified commercial and public sector measures.</td>
</tr>
</tbody>
</table>
### Table 3.2 Energy Efficiency in the Built Environment – Overview of Costs and Emissions Reduction Potential – Mitigating Measures in Place (cont’d)

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<tr>
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<th>Objective of measure</th>
<th>Exchequer Expenditure (€)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reference</td>
<td>Title</td>
<td>Type</td>
</tr>
<tr>
<td>BE 13</td>
<td>Energy Efficiency Obligation Scheme</td>
<td>Regulatory Instrument</td>
</tr>
<tr>
<td>BE 14</td>
<td>Large Industry Energy Network</td>
<td>Economic Instrument – Fiscal Incentive</td>
</tr>
<tr>
<td>BE 15</td>
<td>SME Support</td>
<td>Economic Instrument – Fiscal Incentive</td>
</tr>
<tr>
<td>BE 16</td>
<td>Qualibuild</td>
<td>Education and Training</td>
</tr>
<tr>
<td>BE 17</td>
<td>Schools Technical Bureau</td>
<td>Education and Training with funding support</td>
</tr>
</tbody>
</table>
### Table 3.2 Energy Efficiency in the Built Environment – Overview of Costs and Emissions Reduction Potential – Mitigating Measures in Place (cont’d)

<table>
<thead>
<tr>
<th>Classification of Measure</th>
<th>Objective of Measure</th>
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<th>NPV 2017-2020 (based on economic CBA)****</th>
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<th>Cumulative GHG emissions reduction 2017-2030 (ktCO₂)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BE 13</strong></td>
<td></td>
<td></td>
<td></td>
<td>Direct = -39m</td>
<td>Direct Plus Indirect = -29m</td>
<td>Direct Plus Indirect = -233 (Economic)</td>
<td>130</td>
<td>648</td>
</tr>
<tr>
<td><strong>BE 14</strong></td>
<td></td>
<td></td>
<td></td>
<td>Direct = -7m</td>
<td>Direct Plus Indirect = -4m</td>
<td>Direct Plus Indirect = -179 (Economic)</td>
<td>72</td>
<td>360</td>
</tr>
<tr>
<td><strong>BE 15</strong></td>
<td></td>
<td></td>
<td></td>
<td>Direct = -2m</td>
<td>Direct Plus Indirect = -1m</td>
<td>Direct Plus Indirect = -260 (Economic)</td>
<td>21</td>
<td>106</td>
</tr>
<tr>
<td><strong>BE 16</strong></td>
<td></td>
<td></td>
<td></td>
<td>N/A</td>
<td>N/A</td>
<td>N/A – the impacts will result in improved energy efficiency largely captured elsewhere.</td>
<td>N/A – the impacts will result in improved energy efficiency largely captured elsewhere.</td>
<td>N/A – the impacts will result in improved energy efficiency largely captured elsewhere.</td>
</tr>
</tbody>
</table>

*Direct* = Direct Costs

**Direct** = Direct Costs + Indirect Costs

N/A = Not Applicable

****Economic**** = Economic Costs

MACC = Marginal Abatement Cost Curve

GHG = Greenhouse Gas

CO₂ = Carbon Dioxide
## Table 3.2 Energy Efficiency in the Built Environment – Overview of Costs and Emissions Reduction Potential – Mitigating Measures in Place (cont’d)

| Classification of Measure | Objective of measure                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Exchequer Expenditure (€)                               |
|---------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Reference | Title | Type | Direct Spend | Tax Foregone | Total |
| BE 18 | In place from 2017 | Behavioural Economics Unit | Education and Training | To better understand the important role that behavioural economics and psychology plays in decision making and to encourage and facilitate more people choosing energy efficient and sustainable options, the SEAI is establishing a dedicated Behavioural Economics Unit in 2017, to provide input to policy development and coordinate with the use of this discipline across wider government policy formation. The unit will trial and test interventions including how best to communicate effectively with target groups to achieve the desired outcomes and will assess impacts. | N/A |
| BE 19 | In Place and being enhanced in 2017 | Support Network for Delivery of Public Sector Energy Efficiency Targets | Education and Training with support from grants | The SEAI supports public sector bodies to achieve their 33% energy efficiency target through technical assistance. From 2017, these supports will be enhanced in support of the new Public Sector Energy Efficiency Strategy in establishing a pipeline of larger scale projects. | 10.8m (by SEAI)** |

* Based on present level of funding.

** Marginal cost per tonne figures are per non-ETS tonne and calculated for the 2017-2030 period.

*** Projections for this measure are based on closing gap to target. While the SEAI support element is funded (€10.8m over the period 2017 to 2020), the modelled programme and expenditure for this measure (€39.1m per annum) is not funded. This represents the scale of investment required from across the public sector to close some of the gap to target.

**** Negative NPV is reflected where the costs outweigh the benefits considered over the time-frame of the analysis.
### Chapter 3  Energy Efficiency in the Built Environment

<table>
<thead>
<tr>
<th>Classification of Measure</th>
<th>Objective of measure</th>
<th>Exchequer Expenditure (€)</th>
<th>Exchequer Receipts (€)</th>
<th>Marginal cost per tonne of carbon abated (€) (as per MACC)</th>
<th>Cumulative GHG emissions reduction 2017-2020 (ktCO₂e)</th>
<th>Cumulative GHG emissions reduction 2017-2030 (ktCO₂e)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BE 18</td>
<td>Behavioural Economics</td>
<td>Direct = 3m</td>
<td>Direct Plus Indirect = 4m</td>
<td>Direct = 21m</td>
<td>Direct Plus Indirect = 23m</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Direct** = -266 (Economic)</td>
<td>Direct Plus Indirect = -295 (Economic)</td>
<td></td>
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<td>Direct Plus Indirect = -266 (Economic)</td>
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<td>Direct Plus Indirect = -295 (Economic)</td>
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<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Direct Plus Indirect = -282 (Economic)</td>
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<td></td>
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</tbody>
</table>

* Based on present level of funding.

** Marginal cost per tonne figures are per non-ETS tonne and calculated for the 2017-2030 period.

*** Projections for this measure are based on closing gap to target. While the SEAI support element is funded (€10.8m over the period 2017 to 2020), the modelled programme and expenditure for this measure (€39.1m per annum) is not funded. This represents the scale of investment required from across the public sector to close some of the gap to target.

**** Negative NPV is reflected where the costs outweigh the benefits considered over the time-frame of the analysis.
### Table 3.3 Energy Efficiency in the Built Environment – Overview of Costs and Emissions Reduction Potential – Mitigating Measures under Consideration

<table>
<thead>
<tr>
<th>Reference</th>
<th>Title</th>
<th>Type</th>
<th>Objective of measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>BE 20 Under consideration</td>
<td>Renewable Heat Incentive Financial Support Mechanism</td>
<td>A Renewable Heat Incentive (RHI) is in development as part of the action to meet Ireland’s 2020 renewable heat target. This scheme aims to encourage industrial and commercial energy users to switch from fossil fuels to renewable energy. Feedback from a public consultation from 26 January to 3 March will be taken account of in designing the scheme.</td>
<td></td>
</tr>
<tr>
<td>BE 21 Under consideration</td>
<td>Smart Metering Education Awareness</td>
<td>To facilitate improved energy efficiency by empowering consumers with more detailed, accurate and timely information regarding their energy consumption and costs – empowering them to reduce consumption, spend and emissions. To be rolled out nationally from 2021 subject to the results of a Cost Benefit Analysis (CBA) which is due at the end of 2017.</td>
<td></td>
</tr>
<tr>
<td>BE 22 Under consideration</td>
<td>Minimal Thermal Standards in Rental Properties</td>
<td>Regulation</td>
<td>To improve the energy efficiency of rental properties – reducing energy consumption and emissions and improving comfort levels. The National Strategy to Combat Energy Poverty has highlighted a link between energy poverty and the low levels of energy efficiency in rental accommodation. It also identified the objective, post-2020, of introducing regulatory measures to preclude the rental of the lowest Better Energy Rated (BER) properties in the interests of improving living standards and reducing energy costs for those at risk of energy poverty. A consultation on this issue will be undertaken by DCCAE in 2017.</td>
</tr>
<tr>
<td>BE 23 Under Consideration</td>
<td>Voluntary Housing Association Upgrades Economic Instrument – Fiscal Incentive</td>
<td>To develop and implement a dedicated programme for voluntary housing associations which could better target energy poor homes at a competitive rate. The potential of a pilot scheme to assist in addressing energy poverty by providing grant aid for energy efficiency upgrades through a cluster approach has been identified. This cluster approach would reduce the overall cost of the works.</td>
<td></td>
</tr>
</tbody>
</table>
### Table 3.3  Energy Efficiency in the Built Environment – Overview of Costs and Emissions Reduction Potential – Mitigating Measures under Consideration

<table>
<thead>
<tr>
<th>Classification of Measure</th>
<th>Objective of measure</th>
<th>Exchequer Expenditure (€)</th>
<th>Exchequer Receipts (€)</th>
<th>NPV 2017-2020 (based on economic CBA)</th>
<th>NPV 2017-2030 (based on economic CBA)</th>
<th>Marginal cost per tonne of carbon abated (€) (as per MACC)</th>
<th>Cumulative GHG emissions reduction 2017-2020 (ktCO₂e)</th>
<th>Cumulative GHG emissions reduction 2017-2030 (ktCO₂e)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reference Title</td>
<td>Type</td>
<td>Direct Spend</td>
<td>Tax Foregone</td>
<td>Total Exchequer Receipts (€)</td>
<td>NPV 2017-2020 (based on economic CBA)</td>
<td>NPV 2017-2030 (based on economic CBA)</td>
<td>Marginal cost per tonne of carbon abated (€) (as per MACC)</td>
<td>Cumulative GHG emissions reduction 2017-2020 (ktCO₂e)</td>
</tr>
<tr>
<td>BE 20</td>
<td>Under consideration</td>
<td>TBD</td>
<td>N/A</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
</tr>
<tr>
<td>Renewable Heat Incentive</td>
<td>Financial Support</td>
<td>TBD</td>
<td>N/A</td>
<td>N/A</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
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<td>TBD</td>
<td>TBD</td>
</tr>
<tr>
<td>BE 21</td>
<td>Under consideration</td>
<td>N/A – Cost to be met by energy suppliers which may be passed on to consumers.</td>
<td>N/A</td>
<td>N/A</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
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<tr>
<td>Smart Metering</td>
<td>Education &amp; Awareness</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
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<td>TBD</td>
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<td>TBD</td>
<td>TBD</td>
</tr>
<tr>
<td>BE 22</td>
<td>Under consideration</td>
<td>N/A. Upgrades to be financed by property owners – with possible support under Government energy efficiency schemes.</td>
<td>N/A</td>
<td>N/A</td>
<td>TBD</td>
<td>TBD</td>
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<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
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<td>TBD</td>
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<tr>
<td>BE 23</td>
<td>Under consideration</td>
<td>15.9m</td>
<td>N/A</td>
<td>15.9m</td>
<td>Direct = -19m</td>
<td>Direct = 0</td>
<td>Direct = 4</td>
<td>20</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Direct + Indirect = -17m</td>
<td>Direct + Indirect = 7m</td>
<td>Direct + Indirect = -62 -62</td>
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</tr>
</tbody>
</table>
4 Decarbonising Transport

4.1 Introduction

Overview
This Chapter focuses on the area of transport in the context of developing a National Mitigation Plan. It considers the characteristics and emissions profile of the transport sector in Ireland, looks at how that profile has changed over recent years, and projects how it might develop into the future. The Chapter identifies and discusses the various measures, already being implemented, that are helping to contain and reduce the level of greenhouse gas emissions associated with the transport sector in this country. It also puts forward a range of potential additional measures that are being considered for the future, with the aim of further intensifying efforts to mitigate emissions from the sector; the key considerations, and the broad indicative nature of the costs and benefits associated with such potential measures are also described, as these will be a critical focus of the future policy deliberations, choices and decision-making in this area.

Background
The Government is committed to reducing emissions and building a climate resilient low carbon transport sector by 2050. A number of successful measures have already been introduced to reduce transport sector emissions. Such measures – which are detailed later in this Chapter – include: sustained investment in the public transport network; the introduction of a Biofuel Obligation Scheme; regulations limiting tail pipe emissions in cars; incentives to encourage the purchase of electric vehicles; and redesigning the Vehicle Registration Tax (VRT) and motor tax regimes to promote low carbon emitting vehicles.

A mix of further measures, developments and initiatives will be needed so as to continue to respond to the climate challenge into the future, and these are discussed later in this Chapter. New technology deployment and behavioural change initiatives will need to be advanced across the transport sector, stimulating changes to the way we travel and the types and amounts of fuels that we use. Further initiatives will contribute significantly, such as: implementation of the National Planning Framework (currently being developed by Government) which will help support a more efficient transport system; increasing public transport capacity and securing a shift – where feasible alternatives exist – away from reliance on use of the private car; encouraging the take-up of alternative fuels to petrol and diesel; and expansion of the Biofuel Obligation Scheme to further reduce the concentration of high-emitting fuels.

In addition, the potential role of taxation, the impact of so-called ‘fuel tourism’, and driving behaviour are all also being examined as part of the National Mitigation Plan.

When making decisions relating to further measures to be implemented, careful consideration must be given to the likely impacts on the environment, the economy and the Exchequer as well as their relative contributions to meeting national emission targets. Consideration must also be given to the implications of combining measures and potential interactions compared to stand-alone alternatives. Increasingly, routes to decarbonisation of the transport sector are becoming better understood and more evident. With effective planning, such change should not act as an impediment to progress and economic growth. In fact, it should be expected that moving
towards achieving Ireland’s climate targets can also be associated with deriving additional benefits to our standard of living and health.

All citizens rely on some aspect of the transport system and it is clear that travel patterns are firmly established. These patterns are reinforced by a number of factors including cost, time, accessibility, flexibility, comfort and safety. Undoubtedly, changes will be required to the transport system to enable the sector to contribute to our national policy vision of a low carbon economy. This transformation will take time but the pathway is becoming clearer.

By 2050, the technological ambition is for the nation’s car fleet, along with some of our public transport buses and rail lines, to be low/near zero emissions. Other technologies, perhaps still unknown, will be fuelling larger vehicles. In the meantime, Ireland is seeking to have greater diversification of fuels in the freight sector that includes a mix of natural gas, biogas, electricity (light vans) and renewable diesel or other biofuels. Hydrogen may also play a role although the timing of hydrogen deployment is as yet uncertain.

Emissions from international maritime transport are being tackled as part of a global approach led by the International Maritime Organization (IMO) and emissions from airlines within the European Economic Area (EEA) are part of the ETS, with other international emissions the focus of a recent International Civil Aviation Organisation (ICAO) agreement. The focus of approaches set out in this chapter is on efforts to reduce emissions from the remaining elements of the transport sector, under the non-ETS sector.

Alongside national policy objectives, the transport sector is also bound by certain commitments at EU level. The Renewable Energy Directive specifies a legally binding 10% renewable energy in transport target to be achieved by all Member States by 2020. The Biofuels Obligation Scheme is the primary mechanism being deployed to achieve this target by 2020. Progress is being made in increasing the share of renewable energy in our transport energy. By 2015 this share was 3.3%, or 5.7% when the weightings for double certificates are applied in accordance with the Directive.

The expectation for transport at EU level is most recently expressed in the European Commission’s July 2016 ‘European Strategy for Low-Emission Mobility’. This reiterates the ambition that ‘by mid-century, GHG emissions from transport will need to be at least 60% lower than in 1990 and be firmly on the path towards zero. Emissions from air pollutants from transport that harm our health need to be drastically reduced without delay.’ The main elements of the Strategy include:

- Increasing the efficiency of the transport system by making the most of digital technologies, smart pricing and further encouraging the shift to lower emission transport modes,
- Speeding up the deployment of low-emission alternative energy for transport, such as advanced biofuels, renewable electricity and renewable synthetic fuels and removing obstacles to the electrification of transport,
- Moving towards zero-emission vehicles. While further improvements to the internal combustion engine will be needed, Europe needs to accelerate the transition towards ultra-low- and zero-emission vehicles.

These objectives are reflected in national transport climate policy development and in the measures under consideration in this plan.
4.2 Emissions Profile

Ireland’s emissions profile has changed considerably since 1990, with the contribution from transport increasing by 130% between 1990 and 2015. The agriculture sector remains the highest emitting sector with emissions remaining more or less constant over that time, but the transport sector has been the fastest growing source of GHG emissions over the period. Transport represented 19.8% of Ireland’s non-ETS emissions in 2015, with agriculture at 33%. The transport share of overall national GHG emissions has increased from 9% in 1990 to almost 20% in 2005 and remains now at that 20% level. During this period, there was a significant increase in both economic output and car ownership levels, from around 800,000 cars in 1990 to close to 2 million in 2015 (+149%). There is a strong correlation between Irish GNP and transport GHG emissions, particularly those emissions relating to the freight sector. The challenge is to decouple these pathways and reduce emissions without compromising economic growth. The success of policies relating to vehicle energy efficiency measures in the car and van fleets and the gradual increase in rates of biofuel substitution are examples of initiatives that can support progress in this regard.

Figure 4.1 Transport Sector GHG Emissions 1990 to 2015 (EPA)

In 2013, despite transport emissions having decreased by 23.1% below peak levels of 2007, an increase of 2.1% was reported for the first time in five years. This was followed by another year on year increase of 2.5% in 2014 and 4.2% in 2015.

The decrease in the years 2008 to 2012 reflected both the impact of the economic downturn, combined with carbon taxation, and improvements to energy efficiency in the car fleet underpinned by changes to vehicle registration and motor tax introduced in mid-2008. In addition, the Biofuels Obligation Scheme started operation in mid-2010, with biofuels displacing up to 6% of the petrol and diesel used thus contributing further to reduced emissions.
Demand for transport is experiencing renewed growth. Vehicle use is showing an upward trend with total annual vehicle kilometres for private cars increasing by 10.7% between 2011 and 2015. The private car remains the dominant mode choice in Ireland with 74% of all journeys being taken by car. Ireland’s dependence on the car is more pronounced outside Dublin (79% of all journeys outside Dublin) than in Dublin (63% of all journeys). This profile is largely in line with other similar European countries.

According to the latest GHG emission projections from the EPA, transport emissions are set to increase by 10-16% beyond current levels over the period to 2020, depending on the level of policy intervention (Scenario 1 and Scenario 2). Relative to 2005, transport emissions are projected to remain the same or, at best, decrease by 4% by 2020. The 4% reduction assumes that we will fully achieve energy efficiency and renewable transport targets. Over the longer term, the EPA project that transport sector emissions will increase by 20% over the period 2020 to 2035, driven by a projected increase in the national car fleet to 2.6 million and a projected increase in population to 5.3 million by 2035.\(^{23}\)

**Figure 4.2 Projections of GHG Emissions from the Transport Sector**

It is assumed that the renewable energy penetration in both Scenario 1 and 2 is maintained at 2020 levels in percentage terms supported by the Biofuel Obligation Scheme 2010.

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These projections, based on the assumption that no further policies and measures are implemented post-2020, show that transport is not currently on a low carbon pathway. Measures to shift Ireland onto the desired pathway are likely to have significant cost implications for the State, but can also bring a broad range of benefits in terms of how transport works in Ireland.

4.3 Opportunities and Challenges

Ireland now has annual climate mitigation targets out to 2020 with a further sustainable trajectory being put in place to 2030. Aligning with national and international objectives out to a time horizon of 2050, it is now clear that the scale of greenhouse gas mitigation required over the next decades, and the adjustments needed in the transport sector will pose significant fiscal and policy challenges. Our climate commitments are set against a welcome return to economic growth which will however, coupled with our demographic trends, add significant transport demand pressures. The transport sector must meet this additional demand, while addressing the related congestion, climate mitigation and air quality concerns posed.

Despite very high mitigation costs in the transport sector and projected strong transport demand increases, the transport sector will be required to contribute emissions reductions to the national effort and set Ireland on a trajectory to a low carbon transport future. However, the necessary actions can also deliver benefits, such as improved energy security and economic opportunities from renewable and indigenous fuels. Indeed many important co-benefits arise in areas of health, lifestyle, air quality, travel costs and the local environment, from measures designed to address greenhouse gas emissions reduction in the transport sector.

Settlement Patterns, Transport and Land Use Planning

Transport demand is essentially a derived demand and is largely dependent on the level of activity within an economy. Population growth, labour force participation rates, settlement patterns and changes in the affordability of transport have an impact on demand. Settlement patterns, in particular, play a fundamental role in influencing how people travel, both the distances undertaken and the modal choice. In a European context, Ireland has a particular challenge as we are an island nation with a dispersed population and limited numbers of high density urban settlements suitable for the provision of effective public transport systems. Eurostat data indicates Ireland has the highest percentage population living in rural areas of all EU Member States\(^{24}\).

To effectively meet travel demand in a manner that avoids congestion and limits transport emissions and pollution requires effective spatial policies to be implemented at local and national levels. The spatial relationship between where a person lives, works, goes to school, shops and socialises forms the basis for demand. The provision of sustainable transport options is only realistic when development patterns locate populations close to employment centres and complementary services such as education, retail and leisure. Walking and cycling, in particular, become more viable as transport options when the distance between such services is reduced. It is clear that land use policy is a key determinant of transport investment decisions so it is vital that land use planning and transport planning are fully aligned. The development of a new National Planning Framework will play a critical role in securing this alignment.

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Furthermore, the National Transport Authority (NTA), through its various statutory planning, regulatory and investment functions, is also working in a manner that can deliver a better integration of land use and transport planning, consistent with Government spatial planning objectives.

Multiple Objectives
The transport sector is required to fulfil a number of interdependent and sometimes conflicting policy objectives. Supporting economic growth, both domestically and within our export sectors, has always been a key basis of support of transport investment. Our transport system is expected to respond to the needs of a growing economy, yet remain cost competitive within an international context, particularly for the freight industry. Access to transport is also an important policy consideration in securing social inclusion and equality.

In this context, developing further cost-efficient measures for the sector will be challenging. The marginal abatement cost per tonne of CO$_2$eq in the transport sector is widely recognised as being very high and well in excess of the range of carbon prices considered likely in the ETS by 2020 and beyond. Technical support undertaken by UCC/ESRI/E4sma$^{25}$ in 2013 indicated that the marginal abatement cost of carbon (priced in € per tonne of carbon dioxide) could increase to €335/tonne by 2050 under a scenario to reduce carbon emissions nationally by 80%. This level of carbon abatement cost is not unusual in transport and is in marked contrast to a current carbon tax of €20/tonne and EU-ETS price of less than €10/tonne.

Energy Security and High Dependence on Oil
With a very high dependence on oil (98%), greater diversification of fuels in the Irish transport sector is also highly desirable from an energy security perspective. The use of fossil fuels, particularly petrol and diesel, is firmly embedded in the car driving culture of Ireland. These fuels are also the predominant choice for freight and public transport services. Of the total vehicle fleet, 45.6% of vehicles use petrol while 53.6% operate on diesel. Notwithstanding the levels of efficiency achieved in conventionally fuelled vehicles in recent years, this profile reflects the scale of change that will be required if alternative fuels are to play the role envisaged in our national and EU vision for 2050.

$^{25}$ UCC/ESRI/E4sma “Technical support on developing low carbon sector roadmaps for Ireland” (2013).
Technology
Advancements in technology are at the forefront of changes occurring in the transport sector. Technology will undoubtedly offer one of the most cost-effective and feasible pathways to achieving our mitigation objectives between now and 2020, 2030 and ultimately 2050. Ireland, as a technology taker, will need to be suitably positioned to adapt to an expanding market of alternative fuels and new technologies.

Electric Vehicles and Alternative Fuels
Based on current information, a full electrification of the car fleet could represent a feasible option for Ireland, where supporting grid infrastructure is developed. While there are no certainties in predicting future technologies, there are strong indications from car manufacturers and energy market analysts that mass market adoption will happen for Electric Vehicles (EVs). Advances in battery technology, increasing competition in the market and lower vehicle costs would suggest that electrification will be the predominant low carbon choice for transport, particularly for the private car, taxis and commercial vans. We can expect freight to be fuelled by a range of fuel types or combinations of such types as biogas, biofuels, electricity, hydrogen, CNG and LNG. The level of contribution from biofuels is expected to have limits over the long term due to various resource constraint, demand/supply and land use issues. The first commercial production of hydro-treated vegetable oil (HVO) or renewable diesel took place in the Whitegate Oil Refinery in 2006. Some leading edge research into the production and usage of biogas as a transport fuel is currently being undertaken in the SFI MaREI Centre in UCC.

Role of EU Regulations
EU legislation sets mandatory emission reduction targets for new cars. This legislation is the cornerstone of the EU’s strategy to improve the fuel economy of cars sold on the European market. Similar targets have been set for new vans. The law required that new cars registered in the EU did not emit more than an average of 130 grams of CO₂ per kilometre (g CO₂/km) by 2015. By 2021, phased in from 2020, the fleet average to be achieved by all new cars is 95g CO₂/km. The 2015 and 2021 targets represent reductions of 21% and 42% respectively compared with the 2007 new passenger car fleet average of 164g CO₂/km. The successful implementation of these regulations will be fundamental to a decarbonisation strategy in the short to medium term, particularly up to 2030.

Wider Benefits
Pursuing a low carbon vision for transport will not only contribute to achieving Ireland’s climate change commitments but can also benefit society in terms of lifestyle and the provision of more liveable communities, particularly in urban areas. Aligned with the targets under the EU Climate and Energy Package are headline targets for smart, sustainable and inclusive growth. A greener, low carbon future has the potential to provide benefits for Ireland, particularly if the transport sector is responsive and transitions early in the period to 2050. Implementing smarter travel policy will also accrue significant benefits to people from the perspective of health, travel cost, local environment and air quality. Significant behavioural change will be required to accrue such benefits and a cross-sectoral approach will be necessary to maximise this significant potential.
4.4 Mitigating Measures in Place

Ireland has a comprehensive range of policy measures in place aimed at delivering a low carbon transport system, and these are looked at in this part of the Chapter.

Fiscal Supports

Measure T1 – Public Transport Investment

The quality, capacity, cost and accessibility of public transport are critically important in the context of delivering a sustainable transport sector. Transport climate efforts must be reinforced by continued investment in public transport capacity increases and quality improvements to secure high levels of mode shift. Exchequer funding of approximately €248 million was provided to the NTA in 2016 for Public Service Obligation (PSO) and Rural Transport Programme (RTP) public transport services. In addition the Department of Social Protection provides €80 million annually for the free travel scheme, for which approximately 800,000 citizens are eligible. The Department of Education and Skills also provides approximately €150 million each year in respect of the school transport scheme.

Budget 2017 provided for an 11% increase in the amount of funding for PSO and RTP services and in 2017 a total of €277 million will be made available. This will allow for improved services on our publicly funded bus and rail networks including increased service frequencies on the high capacity DART network, additional services across the bus network and additional capacity on Kildare Line commuter rail services through utilisation of the newly reopened Phoenix Park Tunnel.

The allocation of capital funding for public transport under the Government’s Capital Plan Building on Recovery Infrastructure & Capital Investment 2016-2021 is €3.6 billion. Projects include Luas Cross City which is on schedule to open at the end of 2017, the recently re-opened Phoenix Park Tunnel, the City Centre Re-signalling project, and investment in the bus fleet and bus priority measures. A Green Public Transport Fund was established in 2017 to provide funding for pilot low emission vehicle programmes in the public transport fleet, including taxis.

Measure T2 – Smarter Travel Initiative

The Department of Transport Tourism and Sport (DTTAS) is focused on the promotion of sustainable means of transport – walking, cycling and public transport – through the provision of funding for infrastructure as well as funding for behavioural change programmes to encourage the use of more sustainable transport modes. The Smarter Travel Initiative has been allocated €100m funding under the Capital Plan Building on Recovery: Infrastructure and Capital Investment 2016-2021.

Measure T3 – Low Emission Vehicle (LEV) Incentivisation

Since 2011, the SEAI has been providing grants of up to €5,000 to incentivise consumers to purchase a battery electric vehicle (BEV) or a plug-in hybrid electric vehicle (PHEV). In addition to the grant scheme, such vehicles qualify for VRT relief of between €2,500 and €5,000 depending on the type of low emission technology being used. This provides a maximum combined subsidy (grant plus VRT relief) of €10,000 in the case of a BEV and €7,500 for a PHEV. The grant scheme will continue in 2017. In Budget 2017, it was announced that VRT relief on BEVs will continue until end 2021 with relief until end 2018 for PHEVs. Increasing range performances, decreasing purchase prices and the availability of an extensive nationwide charging network are providing a supportive environment for a widespread transition to electro-mobility.
In addition, a tax incentive for companies paying corporation tax is in place in the form of Accelerated Capital Allowances for Energy Efficient Equipment, supporting the purchase of BEVs, PHEVs, hybrid vehicles and the associated charging equipment.

**Measure T4 – Taxation Policy**

The policy objective of reducing CO$_2$ emissions is reflected in the current charging system for private vehicle motor tax and passenger car VRT. This taxation applies to any passenger cars entering the fleet since 2008. Since January 2013, a revised banding structure was introduced for both motor tax and VRT, splitting the lowest CO$_2$ Band A (1–120 g/km) into four and Band B (121–140 g/km) into two. A zero emissions band for electric vehicles was also introduced for motor tax purposes only. In 2016, 78% of new purchases were in the A Bands and 18% in Bands B. Cars with CO$_2$ emissions of 140 g/km or higher now comprise just 4% of new car purchases. This measure is considered very effective in influencing purchasing decisions by motorists in favour of more fuel efficient vehicles. Future band revisions will need to account for both the efficiency and broader environmental impacts associated with specific vehicles types.

Additionally, a carbon tax, whereby a tax is levied on the carbon content of fuels, was introduced in Budget 2010. The current rate is €20 per tonne of CO$_2$ emitted by the fuel concerned and applies to both petrol and diesel.

The adoption of natural gas as a transport fuel is being encouraged with the excise rate applied set at the minimum rate allowable under the Energy Tax Directive for a period of 8 years. This certainty around the reduced rate is expected to incentivise the uptake of natural gas as a transport fuel which is a much cleaner fuel than diesel as well as provide a pathway for the use of biogas in transport.

**Policy/Regulations**

**Measure T5 – Public Transport Energy Efficiency**

A number of energy efficiency actions have been put in place in recent years in the area of public transport, covering both bus and rail. These initiatives, which encompass technological solutions and changing the behaviour of drivers, will continue to deliver energy efficiency savings and consequential emissions reductions. In addition, a reduction in particulates arising from fuel efficiency will improve air quality. Examples include train configuration changes by Irish Rail and eco-driving initiatives by Dublin Bus and Bus Éireann.

**Measure T6 – Biofuels Obligation Scheme**

To assist in meeting EU renewable energy obligations, the Government introduced a Biofuels Obligation Scheme to ensure that a proportion of the transport fuel used in the State consists of environmentally sustainable biofuels. Broadly the approach is that the fuels are blended together and made available to consumers at the pump. The existing scheme places an obligation on suppliers of mineral oil to ensure that 8.695% (by volume) of the motor fuels (generally gasoline and motor diesel) they place on the market here are produced from renewable sources. This has increased over time from a share of 4.166% in 2010. The biofuel substitution delivered non-ETS GHG emissions abatement levels of c. 0.4 MtCO$_{2eq}$ in 2015 alone.
Measure T7 – National Policy Framework on Alternative Fuels Infrastructure for Transport
To help reduce oil dependency in transport and associated harmful effects, the EU Commission has developed a sustainable alternative fuels infrastructure strategy. Ireland’s National Policy Framework will be published in March 2017 and addresses such infrastructure requirements as EV charging points and natural gas refuelling stations. Minimum requirements (in setting up alternative fuels infrastructure across the EU) are expected to reassure car manufacturers and investors who will make the long term investment decisions needed to promote the use of vehicles powered by alternative fuels.

Measure T8 – Review of Public Transport Policy
The Programme for a Partnership Government commits to a review of public transport policy to ensure services are sustainable into the future and are meeting the needs of a modern economy. This measure reflects the Government commitment to adopting a dynamic approach to managing the needs and evolution of the transport system over time.

Measure T9 – Review of National Cycle Policy Framework
In April 2009, the Government published the first National Cycle Policy Framework. It outlined 19 high level objectives containing 109 actions, aimed at ensuring that a strong cycling culture is developed in Ireland. The Framework set a target that 10% of all journeys will be made by bicycle by 2020. A Review of the National Cycle Policy Framework is currently underway and will be published later this year.

Among the key advantages of intelligent transport systems (ITS) is their ability to enhance the efficiency of infrastructure and fuel use in a transport network. The DTTAS is currently scoping a comprehensive national strategy on ITS

Measure T11 – National Planning Framework
The National Planning Framework, currently under development by the DHPCLG, will provide a framework for national planning, pulling together relevant Government policies and investment on national and regional development. Amongst a number of strategic goals, the Framework aims to integrate land use and transport planning policy in a manner that reduces commuter travel demand and supports more efficient travel. Investment in social, educational, health and employment spheres will all impact on the development of an integrated, efficient and sustainable transport system. Recognising these interactions and setting a longer-term path will help to deliver more sustainable transport over time.

Measure T12 – Aviation Efficiency
The Irish and UK National Supervisory Authorities (NSAs) created the UK-Ireland Functional Airspace Block (FAB) in 2008 to help reduce fragmentation of air navigation service provision across Europe and improve efficiencies. In the first four years of the FAB operation, it delivered over €70m of savings to customers, including 232,000 tonnes of CO₂ from 73,000 tonnes of fuel.
Measure T13 – EU CO₂ Cars/Vans Regulation

The EU, through Regulation 443/2009, aims to improve average new car efficiency i.e. the level of emissions from new cars. Levels will drop over the coming years from 130g CO₂/km by 2015 to a target of 95g CO₂/km for 2021. Emissions from conventional combustion engines will need to fall further after 2021. The European Commission is working on post-2021 carbon dioxide standards for cars and vans and launched a public consultation on options together with a Strategy for Low-Emission Mobility in 2016.

Similar to regulation 443/2009 mentioned above, EU Regulations require that by 2021 average emissions for the new light commercial vehicle fleet fall to a target of 147g CO₂/km. Targeting support within the tax system for early take up of low-emission vehicles as they become available would reinforce the carbon reduction objective of the Regulation.

Measure T14 – Public Sector Energy Efficiency Strategy

The Public Sector Energy Efficiency Strategy was published in January 2017 and notes the importance of public sector fleets for testing new technologies, facilitating and accelerating market uptake of new technologies such as alternative fuels usage and improving the environmental performance and fuel efficiency of the sector at the same time. Beyond fleet focused measures, there is also scope for the promotion of energy efficient measures through modal shift with a focus on travel choices made by public servants.

Research

Measure T15 – Research and Development

The Climate Change Unit of DTTAS is supported by that Department’s Economic and Financial Evaluation Unit which serves as an analytical and research resource. A strong understanding of the challenges and opportunities associated with decarbonising transport over the long term is now being developed across the sector. The Department’s capacity is further supported by the academic sector as well as State Agencies such as SEAI. Departmental and agency analytical/evaluation capacity are kept under review and proposals to scale up such capacity are being considered to meet the substantial technical demands of dynamically monitoring and managing sector performance, planning and evolution.

4.5 Mitigating Measures under Consideration

In the context of the ambition milestone for 2050, the DTTAS has undertaken a review of existing measures to establish if they offer scope for further emission reductions through expansion or extension. A range of new measures have also been considered that could potentially deliver further tangible, cost efficient low carbon results for transport. The aim is to identify those potential measures that could deliver greatest return in emissions reduction, at least cost to the State and the economy. In consultation with key stakeholders, this Plan will be subject to on-going review to ensure that the most effective measures are prioritised.

Some measures proposed are leadership measures and while their individual associated potential emissions savings would be less than 50kt and, accordingly, did not warrant economic analysis, these measures could play a significant leadership and demonstration role in the transition to a low carbon transport sector. It is also important to note that several of the core policy levers that affect the transport sphere – including, for example, taxation policy or fuel
policy – are not within the control of DTTAS, but rather are led by other areas of Government. Because achieving further significant emissions mitigation in the transport sector will depend on policy decisions about these levers being appropriately informed and influenced by climate and transport considerations, this will require continued close co-operation by DTTAS with other key Departments (principally DCCA, DOF and DPER) so as to enable their policies to support transport sector and climate objectives.

**Fiscal Supports**

**Measure T16 – Further Public Transport Investment**
The *Capital Plan Building on Recovery: Infrastructure and Capital Investment 2016-2021* was framed within the context of Government fiscal policy and will allow a significant investment (€3.6bn) in maintaining public transport infrastructure. A mid-term review of the Capital Plan will be carried out this year and the Minister for Transport, Tourism and Sport has signalled his intention to make the case for public transport investment to be both increased and accelerated as part of that review in order to address growing transport needs.

**Measure T17 – Further Low Emission Vehicle (LEV) Incentivisation**
Technology advancement, affordability and consumer choice will be the greatest levers in triggering large-scale change. The *Programme for a Partnership Government* includes a commitment to establish a Taskforce to consider the range of measures and options available to Government to accelerate the take-up of low carbon technologies, especially EVs. It is expected that the work of this LEV Taskforce will be divided into three areas: market growth stimuli and public leadership, charging infrastructure and legislation and planning.

**Measure T18 – Supports and Incentives to Modal Shift**
Potential expansion of existing support schemes such the Public Transport Taxsaver Scheme and Bike to Work Scheme will be considered as part of a sectoral approach to reducing emissions. It is to be noted however, that any expansion of these schemes would incur costs in terms of revenue to the State forgone.

**Measures T19 and T20, Taxation Policy Development**
The role and interrelationship of various elements of the tax system is a key factor in decision making about vehicle purchasing and use. The potential of certain tax policies to underpin a clear pathway and positive policy environment for an early transition to alternative, cleaner fuels will form a key element of the overall approach. Consideration will, of course, need to be given to how important revenue streams can be safeguarded as this transition is implemented.

One approach could involve an increase in carbon tax on petrol and diesel from the current level of €20/tonne to €30/tonne, which, of course, requires consideration on a cross-sectoral basis. Within the transport sector, an increase in carbon tax on transport fuel to €30/tonne would potentially lead to a reduction in cumulative GHG emissions of approximately 1450 ktCO$_2$eq from 2017 to 2030 and could yield c. €1.3bn additional taxation receipts over the same time period.
The growth in transport emissions since 1990 has also been, in part, due to the changed pattern in ‘fuel tourism’, the purchase of fuel in Ireland for use outside the jurisdiction. From a position in 1990 where purchasers regularly travelled North to buy transport fuel, the SEAI estimates that fuel tourism from north of the border currently makes up an estimated 10% of transport energy demand. Due to the internationally agreed methodology for calculating emissions, such fuel purchases are calculated as emissions of the State. They are present on our emissions inventory, despite the fact that the fuel is consumed outside this jurisdiction. In examining the feasibility of price equalisation in order to reduce if not to eliminate fuel tourism, it is clear that the role of exchange rate movements and the potential impact of Brexit add complexity to the design of any potential measures to address this issue. An approach involving a price equalisation model secured through taxation would increase fuel cost to consumers nationally and, potentially, involve job losses in some Border areas. It is estimated, however, that between 2017-2030 elimination of fuel tourism could lead to a reduction in Ireland’s GHG emissions levels of up to 13,000 ktCO$_2$ eq. Any measures implemented which move fuel prices closer to those north of the border should have an impact on fuel tourism and this should remain a key consideration.

**Measure T19:** The motor tax and VRT system could be further amended in line with improvements to energy efficiency and emissions reductions in cars and vans to additionally incentivise or maintain the advantages of purchasing of the lowest emitting vehicles. Such measures require careful design to ensure they are aligned with other policy objectives such as air quality.

**Measure T20:** To encourage the take-up of alternatively fuelled vehicles, removing or reducing supports or preferential treatment for petrol and diesel fuelled vehicles could also be considered. These include the diesel rebate scheme, the benefit in kind scheme as currently designed, the excise differential between petrol and diesel and the VAT recoupment on the purchase of diesel.

The tax system can be a useful mitigation tool but it is important to ensure that it is used to complement other measures rather than bluntly distorting the competitiveness of the overall economy through cost increases without providing alternatives. Further detailed consideration of measures along with the relevant Departments will be required before any change can be made.

**Policy/Regulations**

**Measure T21 – Biofuels Obligation Scheme Development**

It is intended that the biofuel obligation will be incrementally increased on a sustainable basis between 2018 and 2020 to assist meeting the renewable transport target of 10% in 2020. The incremental increases (to a potential maximum of ~11%) will take cognisance of technical and other developments. It is proposed to hold a consultation on further increases to the obligation rate to 2020 in 2017.
Education/Information Initiatives

Measure T22 – Eco-driving

Eco-driving is a term used to describe the energy efficient use of vehicles using driving techniques that can lead to average fuel savings of 5–10%. A campaign aimed primarily at commercial fleets (HGVs and Buses) has potential to reduce emissions. Measures under consideration include the use of a grant to HGV/bus operators where their drivers are trained and in-cab technology is installed to assess and improve driver behaviour.

Longer Term Mitigation Measures

As complementary policies evolve over time, the potential greenhouse gas mitigation effect of certain measures can be better determined and secured. Furthermore, increases in the cost of carbon over time can place measures in the spotlight that had been ruled out in the short-term due to the cost or inefficiency burden they were considered to have imposed. Some such potential longer-term measures are considered in this section.

Measure T23 – National Policy on Parking

A comprehensive national policy on parking should be developed. It should include motorised vehicles and bicycles and Local Authorities should be provided with guidelines to support its implementation as they are responsible for parking provision, planning and related matters.

By reducing the public parking supply by a small percentage every year in urban centres, more space would be available to facilitate services and infrastructure for pedestrians, cyclists, and public transportation. However, any change to parking supply in urban centres would have to be considered in tandem with policies on ‘out-of-town’ parking. A national parking policy would have to complement demand management measures and developments in ITS in context of the EU’s Smart Cities Initiative.

Measure T24: Reduction of Top Speed Limits on Motorways

Energy use increases at higher speeds. While there is a lack of official and robust data on this issue, various sources suggest that moving from 100km/h to 120km/h increases fuel consumption by up to 20%. One option could be to reduce maximum speed limits on motorways from 120km/h to 110km/h for cars/LGVs and from 90km/h to 80km/h for HGVs, which would however need to be considered in the context of the design speed for existing infrastructure. For benefits to be fully realised, this would require a step change in speed enforcement across the country requiring the involvement of the Department of Justice and Equality (DJE), the Gardaí and the Road Safety Authority.
Concluding Comments on Mitigating Transport Emissions

The significant reduction in Ireland’s transport emissions which was achieved between 2007 and 2012 – despite the relative constancy of road passenger kilometres travelled over that time – is important in pointing to some of the approaches that might usefully be deployed for the future with a view to resuming an emissions reduction trajectory in the transport sector. The reduction over that period had three main causes:

- a fall-off in road freight activity, particularly construction freight related strongly to the economic downturn;
- the introduction of a proportion of biofuels into the transport fuel mix under the Biofuels Obligation Scheme; and, very significantly
- a step change in the energy efficiency of the car fleet under the dual track approach of EU-mandated efficiency improvements and changes in car purchasing behaviour secured by changes to the VRT and Motor Tax regimes.

Further profound changes will be required to the transport system if it is to contribute meaningfully to achieving the Government’s national policy vision of Ireland becoming a low carbon economy. To meet the considerable additional transport demand which is expected to arise in the coming years, while also addressing congestion, climate mitigation and air quality concerns, it will be necessary to undertake a significant expansion in public transport capacity, concentrating particularly on suitable urban areas. A comprehensive transition to alternative vehicle technologies will also be necessary, and this will require an enabling and supportive policy environment.

For the future, the key transport measures which are delivering on greenhouse gas mitigation and having important congestion and air quality co-benefits, will be maintained and further developed or augmented as appropriate. Work is already underway on developing an evidence base to support identifying the appropriate additional measures to be prioritised in the short-medium term, and this is being intensified. For the longer term, the work on further examining the range of potential additional measures signalled in this Chapter will help inform policy discussion and choices on these options.

Overall, a wide range of important, complementary policies being developed and implemented across the transport sector will continue to yield important climate dividends. The pathway to a largely decarbonised transport sector is extremely challenging but the various steps along the way are becoming increasingly clearer.
4.6 Overview of Costs and Emissions Reduction Potential

The tables below set out a brief overview of measures in place and under consideration that have been modelled as part of the ongoing cross-Departmental work on evaluating the emissions reduction potential and costs of a range of climate change mitigation measures. The analytical outputs are based on a marginal abatement cost curve approach which assesses the impact of an abatement measure against a set baseline. Common assumptions have been applied for the three energy sectors in relation to key parameters such as the discount rate, fuel costs and shadow prices. It is clear that in certain cases such as motor tax or EV incentives, there are multiple scenarios possible in the design of the measures. The estimates listed below are therefore indicative only of one such scenario. In most cases, it has not been possible to include indirect impacts such as air quality and health benefits but further research in the area of indirect impacts is planned by DTTAS. To date, the measures have each been modelled as stand-alone scenarios; it is envisaged that further work on modelling the interaction between measures will also be undertaken.
## Table 4.1 Decarbonising Transport – Overview of Costs and Emissions Reduction Potential – Mitigating Measures in Place

<table>
<thead>
<tr>
<th>Reference</th>
<th>Title</th>
<th>Type</th>
<th>Objective of measure</th>
<th>Exchequer Expenditure (€)</th>
<th>Direct Spend</th>
<th>Tax Foregone</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>Public Transport Investment</td>
<td>Fiscal Support</td>
<td>Modal shift to public transport or non-motorised transport, Improved behaviour, Improved transport infrastructure.</td>
<td>€750m p.a.*</td>
<td>Nil</td>
<td>€750m p.a.</td>
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</tr>
<tr>
<td>T2</td>
<td>Smarter Travel Initiative</td>
<td>Fiscal Support</td>
<td>Modal shift to public transport or non-motorised transport, Improved behaviour.</td>
<td>€15m p.a.**</td>
<td>Nil</td>
<td>€15m p.a.</td>
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<tr>
<td>T3</td>
<td>Low Emission Vehicle (LEV) Incentivisation</td>
<td>Fiscal Support</td>
<td>Low carbon fuels.</td>
<td>€53m***</td>
<td>€33m****</td>
<td>€86m</td>
<td></td>
</tr>
<tr>
<td>T5</td>
<td>Public Transport Energy Efficiency</td>
<td>Policy/ Regulation</td>
<td>Modal shift to public transport or non-motorised transport, Improved behaviour, Improved transport infrastructure.</td>
<td>Included in T1</td>
<td>N/A</td>
<td>Included in T1</td>
<td></td>
</tr>
<tr>
<td>T6</td>
<td>Biofuels Obligation Scheme</td>
<td>Policy/ Regulation</td>
<td>Low carbon fuels.</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
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</tr>
<tr>
<td>T12</td>
<td>Aviation Efficiency</td>
<td>Policy/ Regulation</td>
<td>Demand management/reduction.</td>
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<td>N/A</td>
<td>N/A</td>
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<tr>
<td>T13</td>
<td>EU CO2 Cars/Vans Regulation</td>
<td>Policy/ Regulation</td>
<td>Efficiency improvements of vehicles.</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td></td>
</tr>
</tbody>
</table>

** Average 2009-2015.  
*** 10,700 €5,000 grants between 2017 and 2023.  
**** VRT relief @€5000 for 6,400 BEVs between 2017 and 2021 & for 300 PHEVs between 2017 and 2018.
### Decarbonising Transport – Overview of Costs and Emissions Reduction Potential – Mitigating Measures in Place

<table>
<thead>
<tr>
<th>Classification of Measure</th>
<th>Objective of measure</th>
<th>Exchequer Expenditure (€)</th>
<th>Exchequer Receipts (€)</th>
<th>NPV 2017-2020 (based on economic CBA)</th>
<th>NPV 2017-2030 (based on economic CBA)</th>
<th>Marginal cost per tonne of carbon abated (€) (as per MACC)</th>
<th>Cumulative GHG emissions reduction 2017-2020 (ktCO₂e)</th>
<th>Cumulative GHG emissions reduction 2017-2030 (ktCO₂e)</th>
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<tr>
<td>Class 1</td>
<td>Class 2</td>
<td>Class 3</td>
<td>Class 4</td>
<td>Class 5</td>
<td>Class 6</td>
<td>Class 7</td>
<td>Class 8</td>
<td>Class 9</td>
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<td>T1</td>
<td>In place</td>
<td>Public Transport</td>
<td>Investment</td>
<td>Fiscal Support</td>
<td>Modal shift to public transport or non-motorised transport, Improved behaviour, Improved transport infrastructure.</td>
<td>€750m p.a.</td>
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<tr>
<td>T2</td>
<td>In place</td>
<td>Smarter Travel Initiative</td>
<td>Fiscal Support</td>
<td>Modal shift to public transport or non-motorised transport, Improved behaviour.</td>
<td>€15m p.a.</td>
<td>Nil</td>
<td>€15m p.a.</td>
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<tr>
<td>T3</td>
<td>In place</td>
<td>Low Emission Vehicle (LEV) Incentivisation</td>
<td>Fiscal Support</td>
<td>Low carbon fuels.</td>
<td>€53m</td>
<td>€33m</td>
<td>€86m</td>
<td>Nil</td>
</tr>
<tr>
<td>T5</td>
<td>In place</td>
<td>Public Transport Energy Efficiency Policy/Regulation</td>
<td>Modal shift to public transport or non-motorised transport, Improved behaviour, Improved transport infrastructure.</td>
<td>Included in T1</td>
<td>N/A</td>
<td>Included in T1</td>
<td>N/A</td>
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<td>T6</td>
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<td>Biofuels Obligation Scheme</td>
<td>Policy/Regulation</td>
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<tr>
<td>T13</td>
<td>In place</td>
<td>EU CO₂ Cars/Vans Regulation</td>
<td>Policy/Regulation</td>
<td>Efficiency improvements of vehicles.</td>
<td>N/A</td>
<td>N/A</td>
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<td>N/A</td>
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</table>

**Average 2009-2015.
***10,700 €5,000 grants between 2017 and 2023.
****VRT relief @€5000 for 6,400 BEVs between 2017 and 2021 & for 300 PHEVs between 2017 and 2018.
## Table 4.2 Decarbonising Transport – Overview of Costs and Emissions Reduction Potential – Mitigating Measures under Consideration

<table>
<thead>
<tr>
<th>Classification of Measure</th>
<th>Objective of measure</th>
<th>Exchequer Expenditure (€)</th>
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<td><strong>Title</strong></td>
<td><strong>Type</strong></td>
<td><strong>Direct Spend</strong></td>
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<td>T17 Under consideration</td>
<td>Further Low Emission Vehicle (LEV) Incentivisation Policy</td>
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<td>€713m</td>
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<tr>
<td>T19 Under consideration</td>
<td>Taxation Policy Development – Motor Tax (Cars) Economic Instrument – Fiscal Incentive</td>
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<td>T19 Under consideration</td>
<td>Taxation Policy Development – Motor Tax (LGVs) Economic Instrument – Fiscal Incentive</td>
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<td>T21 Under consideration</td>
<td>Biofuels Obligation Scheme Development</td>
<td>Regulatory</td>
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<td>T22 Under consideration</td>
<td>Eco-driving Education and Training</td>
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<td>€11.8m</td>
</tr>
<tr>
<td>T24 Under consideration</td>
<td>Reduction of Top Speed Limits on Motorways</td>
<td>Regulatory</td>
<td>€1.0m</td>
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</tbody>
</table>

* Negative NPV is reflected where the costs outweigh the benefits considered over the time-frame of the analysis.
## Decarbonising Transport - Overview of Costs and Emissions Reduction Potential – Mitigating Measures under Consideration

<table>
<thead>
<tr>
<th>Classification of Measure</th>
<th>Objective of Measure</th>
<th>Exchequer Expenditure (€)</th>
<th>Exchequer Receipts (€)</th>
<th>NPV 2017-2020 (based on economic CBA)*</th>
<th>NPV 2017-2030 (based on economic CBA)*</th>
<th>Marginal cost per tonne of carbon abated (€) (as per MACC)</th>
<th>Cumulative GHG emissions reduction 2017-2020 (ktCO₂e)</th>
<th>Cumulative GHG emissions reduction 2017-2030 (ktCO₂e)</th>
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<tr>
<td>T17</td>
<td>Further Low Emission Vehicle (LEV) Incentivisation Policy</td>
<td>To support the uptake of low emission vehicles in the national fleet.</td>
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<td>Economic Instrument – Fiscal Incentive</td>
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<td>Taxation Policy Development – Motor Tax (LGVs)</td>
<td>Economic Instrument – Fiscal Incentive</td>
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<td>€713m</td>
<td>Nil</td>
<td>€23.8m</td>
<td>€292m</td>
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<td>T21</td>
<td>Biofuels Obligation Scheme Development</td>
<td>Regulatory</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
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<td>T22</td>
<td>Eco-driving Education and Training</td>
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<td>€11.8m</td>
<td>€76.2m</td>
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<td>T24</td>
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<td>Regulatory</td>
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<td>€350m</td>
<td>Nil</td>
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<td>-€1.1bn</td>
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Chapter 5  An Approach to Carbon Neutrality for Agriculture, Forest and Land Use Sectors

5  An Approach to Carbon Neutrality for Agriculture, Forest and Land Use Sectors

5.1 Introduction

In line with the EU Council Conclusions in October 2014, the Programme for a Partnership Government highlights the need to focus on balancing the control of agricultural emissions with the economic and social objective of promoting the sustainable development of a rural economy. In aiming to achieve this balance, and in keeping with the high level objective set out in the National Policy Position on Climate Action and Low Carbon Development, sustainable food production should not be compromised.

The land area of Ireland is 6.9 million hectares, of which 4.5 million hectares, or about 65%, is used for agriculture. Some 81% of agricultural land is devoted to grass (silage, hay and pasture), 11% to rough grazing (0.47 million hectares) and 8% to crops, fruit and horticulture production (0.38 million hectares). Beef and milk production currently account for 68% of agricultural output at producer prices. Ireland’s livestock numbers in June 2015 included 6.9 million cattle, 5.1 million sheep and 1.5 million pigs which represents peak annual numbers as the December census is generally lower due to a predominantly grassland based production.

Figure 5.1

Source: Central Statistics Office Quarterly National Household Survey (Q1 2016)

27 DAFM (2017) Fact Sheet on Irish Agriculture.
29 DAFM (2017) Fact Sheet on Irish Agriculture.
The agri-food sector is Ireland’s largest indigenous manufacturing industry, with total agri-food employment, including on-farm employment in primary agriculture, forestry and fishing, as well as the food processing industry, accounting for over 165,700 jobs. The most recent data available\(^{31}\) shows the agri-food sector accounting for 7.6% of Gross Value Added\(^{32}\) (2014), 23% of all manufacturing turnover (2014), 8.4% of employment (2015) and 10.7% of merchandise exports (2015). This national economic significance is enhanced by the use of indigenous raw material, low profit repatriation, export orientation and a high level of economic expenditure, particularly in the rural economy. Balancing the environmental objective of reducing greenhouse gas emissions with the economic and social objective of promoting the sustainable development of a rural economy is critical. The industry-led Food Wise 2025 Report, launched in 2015, provides a strategic plan for the sustainable future growth and development of the sector. Sustainability is at the core of the strategy with an Environmental Sustainability Committee in place to monitor and drive the implementation of the sustainability actions while ensuring sustainable food production is not compromised.

Ireland’s national forest estate covers 750,000 hectares (end of 2015), or close to 11% of the land area of the country. Since 1990, over 312,000 hectares have been afforested. Despite this rate of planting, the level of forest cover is low by European standards where the average among the then EU-27 stands at 37%. Coniferous forest is the dominant type, representing 74% of all forests. Broadleaf forests represent 26%. The forest industry, comprising the growing, harvesting and processing of forest products, makes a significant and increasing contribution to the Irish economy. It is estimated that the economic value of the forest sector in 2014 was €2.3 billion\(^{33}\), when both indirect and induced effects are taken into account. The sector is responsible for approximately 12,000 jobs in the economy. Wood processing in Ireland is export-led. In 2014, exports of forest products were valued at €320 million.

### 5.2 Emissions Profile

The IPCC AR5 shows that agriculture, forestry and other land use (AFOLU) is responsible for 24% (10–12 GtCO\(_2\)eq per annum of man-made GHG emissions in 2010) of the world’s emissions roughly split 50:50 between agriculture and forestry emissions. In Ireland, agriculture accounts for about 33% of national emissions\(^{34}\). This figure reflects the importance of agriculture to the Irish economy, the significance of an efficient grass based livestock industry and Ireland’s lack of heavy industry. On the other hand, the forest sector, through afforestation and the use of forest-based biomass and wood products offers considerable scope for climate change mitigation, equivalent to 20-22% of agricultural emissions. Forests also have a role to play in adaptation measures such as the potential to attenuate flood peaks in certain catchments.

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31 DAFM (2017) Fact Sheet on Irish Agriculture.
32 This is a general economic indicator it and means that the sector grew by 7.6% during 2014.
33 [http://www.coford.ie/media/coford/content/researchprogramme/thematicareapolicyandpublicgoods/FORECON%20Final%20report%20owres.pdf](http://www.coford.ie/media/coford/content/researchprogramme/thematicareapolicyandpublicgoods/FORECON%20Final%20report%20owres.pdf)
Methane (CH\textsubscript{4}) and nitrous oxide (N\textsubscript{2}O) make up the majority of Irish agriculture GHG emissions, mainly due to the dominance of cattle and sheep livestock production. Methane is the most significant GHG emitted from agricultural activity in Ireland, accounting for 63% of total agricultural emissions. Enteric fermentation, which is a natural process in the digestive system of ruminant animals that results in the emission of methane, accounts for 90% of agricultural methane emissions. The remaining agricultural methane is associated with the storage and management of animal manures which may present opportunities, albeit limited, for methane recovery through the future deployment of anaerobic digestion technologies. N\textsubscript{2}O emissions arise mainly from applications of nitrogen-based fertiliser and animal slurries to agricultural soils. N\textsubscript{2}O contributes up to 35% of Ireland’s agricultural GHG emissions.

Emissions from agriculture reached a peak in 1998 and have decreased to below their 1990 level since 2002. This reflects a long term decline in livestock populations and in fertiliser use due to policies and measures implemented under the Common Agricultural Policy (CAP). The recent provisional GHG emissions data for 2015, published by the EPA indicate that agriculture emissions are 5.7% below 1990 figures. This overall reduction in emissions from agriculture has also been influenced by measures such as the Rural Environmental Protection Scheme, Agriculture Environmental Options Scheme, Green Low Carbon Agri Environmental Scheme, Organic Scheme, supports for manure management in line with the EU Nitrates Directive, the Afforestation Programme, and through development of renewable energy resources.
The most recent projections, which take into account Food Wise 2025, project agricultural emissions to be in the region of 20.6–20.8Mt CO$_2$eq in 2020. This is just below the 2005 level and will put considerable pressure on the sector, despite the significant improvements to emissions intensity that have been achieved. The long-term ambition is to move towards an approach to carbon neutrality which does not compromise capacity for sustainable food production.

5.3 Opportunities and Challenges

Reducing GHG Emissions in Agriculture

In the period to 2020, even with the adoption of technically feasible mitigation options for Ireland’s agricultural sector, and with supports under the Rural Development Programme, emissions are likely to flat-line at best. It is important to recognise that flat-lining in emissions would represent significant ambition by the Government in addressing agriculture-related emissions, rather than complacency. Farming involves complex natural cycles, and mitigation in agriculture cannot be addressed, as in other sectors, by one-off technological fixes. In terms of emissions per unit of product, dairy and beef production in Ireland are recognised as being highly efficient, a fact independently acknowledged by the EU Commission’s Joint Research Centre. Emissions intensity per calorie of food output in 2013 has reduced by approximately 14% relative to 2005 and early estimates project that the BAU 2030 emission intensity will be a quarter below the emission intensity in 2005. This achievement has been delivered as a result of continued research, advances in animal genetics, health and nutrition, and through optimising the use of fertilisers.
In the longer term, the agriculture sector faces the challenges of reducing GHG emissions while responding to an increased need for food driven by a growing global population and rising affluence. The OECD (2012) estimates that by 2050, the world population will reach 9 billion (compared to 7 billion currently), 70% of whom will live in urban areas. This will significantly increase the demand for food, by up to 70% globally between 2005 and 2050, and place further pressures on the environment. In this context, the opportunities for sustainably produced Irish food and drink products are considerable.

The Teagasc Marginal Abatement Cost Curve (MACC) for Irish Agriculture (April 2012)\(^{35}\) quantified the opportunities for abatement of agricultural greenhouse gases, as well as the associated costs and benefits.

While there is limited potential for additional cost-effective mitigation using existing technologies and practices, the MACC analysis was key in informing the suite of priority measures selected for implementation, as set out in Section 5.4 below.

**Mitigation Potential of Forests and Forest Products**

At the global scale, forests represent the largest terrestrial carbon store, containing an estimated 1,246 billion tonnes of carbon, or 61% of the total terrestrial store. Avoiding and reducing emissions from deforestation is the first priority at the global level. Removal of forest cover releases CO\(_2\) and other GHGs into the atmosphere. Likewise, the functioning and management of forests are critical for climate change mitigation. When sustainably managed, combined with the use of harvested wood products (which stores carbon and displaces emissions arising from the use of high embodied energy products) in construction, other long-lived uses, and as a substitute for fossil fuels, they contribute to both the removal of CO\(_2\) and a reduction of GHG emissions to the atmosphere.

Ireland has a target\(^{36}\) to expand forest cover from the current 11% of the land area of the country to 18% by 2050, with all of the expansion expected to come from agricultural land. The current Forestry Programme envisages afforestation of 7,140 hectares in 2017, increasing incrementally to 8,290 hectares in 2020. Over the timeframe 1990 to 2030, it is estimated that the cost to the state of the afforestation programme will be €3.2 billion. Over the period 2021 to 2030, afforestation since 1990 (i.e. all new forests planted since 1990 and up to 2020) will remove an estimated net 4.5 million tonnes of CO\(_2\) from the atmosphere per annum\(^{37}\) based on the current method of accounting in EU Decision 529/2013.

Under the 2016 Effort Sharing Regulation (ESR) proposal\(^{38}\), Ireland has potential to mitigate 2.7 Mt CO\(_2\)eq per annum from LULUCF (land use, land-use change and forestry) activities in order to meet its emission reduction requirements, based on a combined contribution of net afforestation (afforestation less any deforestation emissions) and cropland and grassland management.

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35 [https://www.teagasc.ie/media/website/publications/2012/1186/1186_Marginal_Abatement_Cost_Curve_for_Irish_Agriculture.pdf](https://www.teagasc.ie/media/website/publications/2012/1186/1186_Marginal_Abatement_Cost_Curve_for_Irish_Agriculture.pdf)


Renewable Energy

Analysis by the SEAI indicates that approximately 1,000 ktoe of bioenergy will be required per annum to meet the country’s 2020 renewable energy targets. Of this, heating will require 475 ktoe, transport 370 ktoe, with the remaining 155 ktoe required for electricity. Achieving the anticipated renewable energy usage in the three energy sectors will be very challenging. The development of resources nationally to contribute to meeting demand will depend on the price of biomass, so that producers can see an incentive to get into production, and also on the removal of barriers to mobilisation, which are being addressed through the Draft Bioenergy Plan, and the Coillte-Bord na Móna Joint Venture.

The sustainability of biomass will continue to be a critical consideration in the development of bioenergy policy under EU Directive 2015/1513, (and the now recast proposals under the ‘EU Winter Package’) which addresses the potential impact of Indirect Land Use Change and seeks to shift the focus away from first generation biofuels (from oils and sugar) and encourage investment in advanced biofuels, such as those produced from municipal waste and agricultural residues, that do not compete directly with food and feed crops. The circular economy, or bioeconomy, also provides opportunities for forest-based biomass and residues, such as animal by-products, to be used to produce heat and/or power through combustion or anaerobic digestion.

Research

Existing and emerging research becomes critical in identifying what and how carbon efficiency can be achieved. Ireland has significant expertise that can help the country become a leader in making the agri-food sector less carbon-intensive and more efficient, and in managing forest resources to optimise mitigation benefits from forest expansion, forest management, and the use of forest products. The Department of Agriculture, Food and the Marine (DAFM) and Teagasc are active in EU and international research groups on GHG such as the EU Joint Programming Initiative on Agriculture, Food Security and Climate Change (JPI-FACCE) and the Global Research Alliance (GRA) on Agricultural GHG.

Irish agricultural GHG research is focussed on understanding the key processes involved in the production of methane and N₂O emissions; developing key mitigation strategies such as dietary strategies, manure management, fertiliser technologies as well as researching future technologies; quantifying the carbon sequestration potential of agricultural soils; refining of emission factors and land-use factors associated with agriculture, forestry and other land use; and the development of climate smart and climate resilient production systems and GHG decision support systems for farmers.

There are two Strategic Research Agendas which identify sector research priorities and include relevant climate change related research areas. These are the Sustainable, Healthy Agri-food Research Plan (SHARP), published by a working group hosted by the DAFM in June 2015, and Forest Research Ireland (FORI) developed by a Working Group of the Competitive Forest Research for Development Council and published by the DAFM in October 2014. Exchequer-funded calls for public good research are made under the three DAFM competitive research funding programmes: Food Institutional Research Measure (FIRM), the Research Stimulus Fund (RSF), and the Programme of Competitive Forest Research for Development (COFORD).
Some €16 million in funding has been committed in projects in the sustainable land management, bioeconomy and GHG related areas arising from DAFM’s Research Calls, launched in the 2010–2015 period.

Under Ireland’s National Biodiversity Plan and the National Peatlands Strategy, a number of DAFM and EPA-funded projects are investigating the use of remote sensing (principally radar and optical techniques) data to detect changes in vegetation that will indicate either changes in land-use or land management. Further investigation will also be necessary to analyse synergies between these policies and mobilising carbon credits under the LULUCF flexibility in particular related to emissions and removals from grassland and cropland activities.

**Behavioural Change**

Many of the measures to mitigate agricultural emissions are dependent on behavioural change, from farmers in particular. This is a complex area incorporating many interdependent motivational factors. However, research shows access to information, contact with Government agents, and participation in farmers’ networks or watershed groups are important to achieve the necessary behavioural change to mitigate GHG emissions. The incorporation of knowledge transfer groups and other information services in the agriculture measures in this plan acknowledges the importance of behavioural change in achieving GHG reduction targets.

FoodWise 2025 and Origin Green39 create the framework and enabling environment to underpin future ambition for the agriculture and land sector to ensure that sustainable food production is not threatened, while focusing on improved agricultural resilience, productivity and resource efficiency and simultaneously encouraging good land management practices with a vision for a near carbon-neutral agricultural (AFOLU) sector. Ensuring sustainable food production is a basic tenet of the UNFCCC as expressed in Article 2 of the Paris Agreement.

### 5.4 Mitigating Measures in Place

Ireland has a comprehensive range of policy measures currently in place aimed at approaching carbon neutrality in the agriculture, forest and land use sectors.

The Common Agricultural Policy (CAP) has made an increasingly significant contribution to the environmental sustainability of the European agri-food sector in recent years and is delivered through two pillars. Pillar One provides a level of income support to farmers while introducing practices that are beneficial for the environment and climate on most of the utilised agricultural area. Pillar Two – The Rural Development Programme (RDP) is the framework for sustainable management of the natural environment in which agricultural activity takes place. As stated above, the Teagasc MACC analysis was key in informing the suite of priority measures selected for implementation through the RDP.

Both programmes are subject to rigorous review processes including an Ex-Ante, Mid-Term and Ex-Post Evaluation in the case of the RDP. Under State Aid rules, the Forestry Programme is subject to ongoing review and is now beginning a mid-term review.

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39 The Origin Green sustainability development programme, which operates on a national scale, unites government, the private sector and food producers for a common vision to improve the environmental performance of individual farms and food producers.
In the main, the focus of the other agriculture measures outside of the RDP is on increasing environmental knowledge and environmental best practice to improve the depth and quality of environment protection and enhancement at individual farm level. Based on developments in research and innovation, which arises through the significant research program, DAFM will seek to keep opportunities for further policy and measure evolution under regular review so as to maximise ways to explore and experiment options to drive our approach to carbon neutrality.

It should be noted that the effectiveness of mitigation measures needs to be evaluated for individual agricultural systems based on climate, social setting and historical patterns of land use and management. There is no universally effective suite of measures. An outline of the key agriculture and forestry measures currently in place is set out below.

**Agriculture**

**Measure AF1A – Cross compliance and Green Direct Payment**

Cross compliance requirements, as per EU regulations include statutory management requirements (SMR) regarding environment, food safety, animal health and welfare and plant health. In particular the Nitrates SMR, which Ireland has a whole territory approach, has significant synergies with reducing N$_2$O emissions and improving nitrogen use efficiency. Additionally many of the good agricultural and environmental condition standards protect soil quality and landscape features such as hedgerows.

Compulsory Green Direct Payment rewards farmers for respecting three obligatory agricultural practices: maintenance of permanent grassland, ecological focus areas (EFA) and crop diversification; all of which have climate action benefits by protecting soil carbon pools under permanent grassland and encouraging landscape resilience through crop diversification and establishment of EFAs.

**Measure AF2A – Beef Data and Genomics Programme (BDGP)**

The objective of the programme is to collect data including DNA samples on maternal traits of suckler cows from commercial farms to feed into a breeding index. The index will inform farmers in selecting robust and resource efficient suckler cow replacements thus lowering the intensity of GHG emissions by improving the quality and efficiency of the national beef herd. The carbon navigator is a key component which allows farmers to monitor progress in improvements and compare themselves against peers on similar land types.

**Measure AF2B – Knowledge Transfer Programme**

The programme facilitates the transfer of information from research and advisory services to farmer discussion group networks that cover a wide range of topics, including sustainability and husbandry practice that contributes to climate mitigation (e.g. animal health, breeding, nutrient management).

**Measure AF2C – Green, Low Carbon, Agri-Environment Scheme (GLAS)**

GLAS is an agri-environmental scheme that incentivises agricultural production methods to address issues of climate change, water quality and biodiversity loss. The scheme supports low carbon agriculture through a range of cross-cutting measures, and promotes the delivery of targeted environmental advice and best practice at farm level.
Measure AF2E – Targeted Agricultural Modernisation Schemes (TAMS II)
The scheme supports capital investment in a number of target areas which will promote, among other things, sustainability (e.g. low emissions slurry spreading equipment, farm nutrient storage, and renewable energy and energy efficiency).

Measure AF2F – Organic Farming Scheme
The scheme promotes organic agriculture as an alternative farming system, contributing to improving soil quality, and mitigation and adaptation to climate change.

Measure AF3 – Smart Farming Programme
This programme, developed by the EPA and the Irish Farmers Association (IFA), supports the measurement, monitoring and improvement of the environmental performance of farms. Further details can be found at the following link: http://smartfarming.ie/

Measures AF4 and AF7 – Business, Environment and Technology through Training Extension and Research (BETTER) Farms Programme
This programme includes a number of working farms as a means of demonstration, channelling research knowledge and outputs to practising farmers via discussion group networks. Further details can be found on the Teagasc website: https://www.teagasc.ie/

AF5 – Pasture Profit Index
The Pasture Profit Index is a guide to assist farmers planning to re-seed in order to maximise yield. By increasing the quantity of grass available for in situ grazing by livestock and reducing the need for external concentrate inputs it provides climate mitigation co-benefits. This is consistent with the grass based husbandry system that Ireland promotes.

AF 6 – Animal By-Products
The objective is to encourage the use of animal by-products (e.g. tallow as a substitute for imported heavy fuel oil, and poultry litter as a biomass energy source).

AF 8 – Origin Green
The Origin Green sustainability development programme, which operates on a national scale, unites government, the private sector and food producers for a common vision to improve the environmental performance of individual farms and food producers. Further details are available at the following link: http://www.origingreen.ie/

AF 9 – The Carbon Navigator
The Carbon Navigator delivers feedback and advice on practices that effectively reduce the carbon-footprint of farm produce, and improve the economic performance of the farm. Further details can be found on the Teagasc website: https://www.teagasc.ie/
Forestry

AF10A – Afforestation Scheme
This scheme aims to encourage landowners to convert land from agricultural production into forestry. Grants covering 100% of establishment costs are provided, along with 15 annual premium payments. Such planting undergoes a rigorous approvals process which ensures forests are established in appropriate areas. Management plans are required for all grant aided forest.

AF10B – Forest Road Scheme
Forest roads provide access to forests for management activities such as thinning and clear-fell, which can increase total cumulative carbon sequestration in the long term and produce long-lived wood products. This scheme provides grants to cover 100% of costs incurred in building such roads to ensure that the requisite access and infrastructure are put in place.

AF10C – Woodland Improvement Scheme
This scheme provides financial support to forest owners towards the cost of woodland improvement works associated with tending and thinning of broadleaf forests planted since 1980, as well as enhancing the environmental qualities of existing predominantly broadleaf forests. This scheme can increase forest quality, productivity and carbon sequestration potential.

AF10D – Reconstitution of Woodlands Scheme
The objective of this scheme is to restore the forest back to its original form following significant damage by natural causes but excluding damage caused by fire and wind blow. Natural causes eligible for funding include damage associated with frost, diseases, deer, grey squirrel and vole. The scheme also aims to maintain or restore forest ecosystems and biodiversity.

AF10E – Native Woodland Conservation Scheme
The objective of this scheme is to support the appropriate restoration of existing native woodlands and, where appropriate, the conversion of existing non-native forest to native woodland, in order to promote the restoration of Ireland’s native woodland resource and associated biodiversity.

AF10F – NeighbourWood Scheme
The NeighbourWood Scheme funds the development of attractive close-to-home woodland amenities (or ‘neighbourwoods’) for public use and enjoyment. The scheme is available to local councils, private landowners and others, working in partnership with local communities. The measure delivers direct environmental and societal value through carbon sequestration and public amenity.

AF10G – Innovative Forest Technology Scheme
This scheme supports smaller scale technologies which are applicable to private forest holders, producer groups, forest contractors and haulage operators. These include innovations that can protect the environment such as variable tyre pressure systems that reduce damage to roads when hauling timber.
AF10H – Forest Genetic Reproductive Material Scheme
The scheme supports the conservation and development of Ireland’s forest genetic resource, key to maintaining productive and healthy forests.

AF10I – Forest Management Plans
These plans provide details on the future management of forests, detailing information such as stock assessment, nutrient assessment, average height and yield class, planting year, and the projected years for first thinning(s) and clear-fell for each plot.

5.5 Mitigation Measures under Consideration

Agriculture
The Marginal Abatement Cost Curve (MACC) referred to in section 5.3 has been updated and is almost finalised. The updated MACC quantifies the abatement potential of the agriculture, forest sector and land use sector for the period 2021-2030. One such measure is a switch in fertiliser type, with research showing that switching to a protected urea product can be effective in reducing both greenhouse gas emissions and ammonia emissions. The research supporting the benefits of this protected urea product is also showing that updated emission factors can have a positive impact on the sector’s emission profile. Currently there is only one manufacturer of this product and it is gaining some market share.

Future mitigation measures are also dependent on the success of 2014-2020 measures and the availability of CAP and exchequer funding. The requirements of the common monitoring and evaluation framework (CMEF) of the CAP and the mandatory ex-post review of the RDP will inform policy decisions on mitigation measures and CAP negotiations for the next Programme period.

An additional consideration to note is that Rural Development Programmes must balance climate change mitigation with measures to fulfil other economic and social priorities identified for rural areas.

Forestry
AF10J – Forest Cover Expansion Post-2020
This policy is set out in ‘Forests, products and people’, the DAFM Forest Policy Review (2014). The Review sets a goal for the expansion of forest cover to 18% by mid-century. The analytic framework for the policy takes into account the need to continue the climate change mitigation benefits of forests and forest products out to the mid-century period, as well as sustaining wood production and other ecosystem services. Future work will analyse the climate change mitigation implications based on what has been achieved under the current programme.
5.6 Overview of Costs and Emissions Reduction Potential

The table below sets out a brief overview of emissions reduction potential and costs for the agriculture and forest sector mitigation measures at Rural Development Programme and Forest Programme level. It is important to note that the measures under these programmes are interlinked and have multiple co-benefits and therefore, should be reviewed as a package rather than standalone. For example, the low emissions farming practices supported by the RDP are set to go beyond the sustainable farming practice enshrined in the Irish legislative framework which includes the nitrates action program and the cross compliance standards that contribute to the protection of the carbon pool stored in Irish farmland.
### Table 5.1 Agriculture, Forest and Land Use – Overview of Costs and Emissions Reduction Potential

<table>
<thead>
<tr>
<th>Classification of Measure</th>
<th>Objective of measure</th>
<th>Exchequer Expenditure (€)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Direct Spend</td>
</tr>
<tr>
<td>AF 2</td>
<td>Overarching benefits for rural environment, including climate change mitigation, preservation of habitats and species, and maintaining good water quality.</td>
<td>1865.15m*</td>
</tr>
<tr>
<td>In place</td>
<td>Rural Development Programme Economic Instrument – Direct Investment</td>
<td></td>
</tr>
<tr>
<td>AF 10</td>
<td>Increase level of forest cover; Increase supply of forest based biomass to bridge expected supply gap by 2020 and beyond; Increase timber mobilisation by supporting private forest holders in actively managing their forests; Enhance the environmental and social benefits of new and existing forests.</td>
<td>€132.5m</td>
</tr>
<tr>
<td>In place</td>
<td>Forestry Programme Economic Instrument – Direct Investment</td>
<td></td>
</tr>
</tbody>
</table>

* Total RDP funding for climate change included in mitigation plan measures (money out of exchequer).

** Funds flow in to exchequer – EAFRD funds.

*** As biological systems, the carbon sequestration capacity of forests is limited while young but increases rapidly. These figures only relate to afforestation over the identified timeframe and do not represent the full value of the forestry programme.
### Table 5.1: Agriculture, Forest and Land Use – Overview of Costs and Emissions Reduction Potential

<table>
<thead>
<tr>
<th>Classification of Measure</th>
<th>Objective of measure</th>
<th>Exchequer Expenditure (€)</th>
<th>Exchequer Receipts (€)</th>
<th>NPV 2017-2020 (based on economic CBA)</th>
<th>Marginal cost per tonne of carbon abated (€) (as per MACC)</th>
<th>Cumulative GHG emissions reduction 2017-2020 (ktCO₂e)</th>
<th>Cumulative GHG emissions reduction 2017-2030 (ktCO₂e)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AF 2</td>
<td>In place Rural Development Programme Economic Instrument – Direct Investment</td>
<td>1,865.15m*</td>
<td>1,066.95m**</td>
<td>Approx €550</td>
<td>1,454</td>
<td>10,054</td>
<td></td>
</tr>
<tr>
<td>AF 10</td>
<td>In place Forestry Programme Economic Instrument – Direct Investment</td>
<td>€132.5m</td>
<td>€0</td>
<td>€132.5m</td>
<td>€0</td>
<td>Approx €20</td>
<td>120***</td>
</tr>
</tbody>
</table>

*Total RDP funding for climate change included in mitigation plan measures (money out of exchequer).
**Funds flow in to exchequer – EAFRD funds.
***As biological systems, the carbon sequestration capacity of forests is limited while young but increases rapidly. These figures only relate to afforestation over the identified timeframe and do not represent the full value of the forestry programme.
Annex 1 – Questions and Policy Options

**Electricity Generation**
1. What further contribution should renewable electricity make towards progressing the transition to a low carbon society and economy? How should this be facilitated?
2. In conjunction with the need to improve the energy efficiency of the built environment through deeper levels of renovation, how do we realise the opportunities that decarbonisation of large scale electric power generation provides to decarbonise the heating and transport sectors through electrification?
3. How can we enhance community engagement with decarbonisation of the electricity system, including achieving greater social and community acceptance of necessary associated electricity infrastructure?
4. How can spatial planning for renewable electricity infrastructure be made more efficient and effective?
5. What other renewable technologies should be considered in order to diversify the power generation mix and progress the transition to a low carbon society in a cost-efficient and cost-effective way?

**Energy Efficiency in the Build Environment**
1. What further practical measures could be introduced to encourage and enable householders in undertaking deep energy efficiency renovations to their homes?
2. How should the Government support those who do not have the financial means to engage in renovations, for example those in energy poverty?
3. How can we motivate the construction industry to promote deeper energy renovations to their clients?
4. For those householders and businesses that have carried out energy efficiency improvements, how should we encourage the adoption of low carbon heating solutions, including those that would facilitate the decarbonisation of electricity generation?
5. How could the regulatory regime be developed to best complement Government incentives and supports for the residential and commercial sectors post-2020?

**Sustainable Transport**
1. The demand for transport can be expected to increase over the coming years. Improving the integration of land use and transport planning is one approach that should help address this challenge. How else could the Government manage this projected change in order to ensure a functioning, low carbon transport network that supports growing communities and businesses?
2. Behavioural changes amongst motorists will be critical in reducing Ireland’s GHG emissions. What practical measures would encourage individual motorists to be ‘greener’? How can we promote a transition to cleaner vehicle types; or a change from conventionally fuelled vehicles to alternatively fuelled vehicles; or an adoption of eco-driving styles?
3. What factors discourage people from transitioning to ‘greener’ transport modes (i.e. walking, cycling, public transport, green cars)? How can the Government stimulate an increased uptake of ‘greener’ transport modes?

4. As a small economy, Ireland has limited influence on the international pace of progress and market development for alternative fuels and technologies. Should the Government consider early investment in the adoption of these alternative fuels and technologies or delay investment until they advance further and become more cost-efficient and cost-effective?

5. At present, Irish businesses are predominately reliant on the heavily-emitting road freight sector for transporting goods throughout the country. What measures could the Government, or businesses, employ to accelerate the decarbonisation of the Irish freight sector?

**Agriculture, Forest and Land Use Sectors**

1. How do you see the potential for carbon sequestration in the agriculture and forest sector contributing to mitigating emissions from the sector?

2. How can *FoodWise 2025* further contribute to Ireland’s approach to climate neutrality for the agriculture and forest sectors without compromising our capacity for sustainable food production?

3. Are there certain policies, measures or actions that have been particularly efficient and effective in reducing GHG emissions and are there policies and abatement strategies that should be considered as levers to develop an approach to carbon neutrality for the sector and help to transition to a low carbon economy?

4. Are there any components of the bioeconomy that have been omitted that could contribute to achieving Ireland’s 2020 and 2030 climate and energy targets?

5. How should we engage with stakeholders to create a stronger enabling environment to ensure the contribution from agriculture is fairly recognised?

6. How can we encourage land owners to convert agricultural land to forest use?

7. How can forests be managed to obtain a higher level of uptake of carbon from the atmosphere?

8. Is there a role for small woodlots/agroforestry on farms to sequester carbon and as a source of fuel and wood products, and how could this be tied in to farm practices?

9. How can a greater level of wood use in the built environment be encouraged?

10. What are best ways to use wood materials for energy and heat generation?
Annex 2 – Acronyms

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AA</td>
<td>Appropriate Assessment</td>
</tr>
<tr>
<td>BAU</td>
<td>Business As Usual</td>
</tr>
<tr>
<td>BER</td>
<td>Building Energy Rating</td>
</tr>
<tr>
<td>BEV</td>
<td>Battery Electric Vehicle</td>
</tr>
<tr>
<td>CAP</td>
<td>Common Agricultural Policy</td>
</tr>
<tr>
<td>CCAC</td>
<td>Climate Change Advisory Council</td>
</tr>
<tr>
<td>CH₄</td>
<td>Methane</td>
</tr>
<tr>
<td>CO₂eq</td>
<td>Carbon Dioxide equivalent</td>
</tr>
<tr>
<td>DAFM</td>
<td>Department of Agriculture, Food and the Marine</td>
</tr>
<tr>
<td>DCCAE</td>
<td>Department of Communications, Climate Action and Environment</td>
</tr>
<tr>
<td>DHPCLG</td>
<td>Department of Housing, Planning, Community and Local Government</td>
</tr>
<tr>
<td>DTTAS</td>
<td>Department of Transport, Tourism and Sport</td>
</tr>
<tr>
<td>EPA</td>
<td>Environmental Protection Agency</td>
</tr>
<tr>
<td>ESD</td>
<td>Effort Sharing Decision</td>
</tr>
<tr>
<td>ETS</td>
<td>Emissions Trading Scheme</td>
</tr>
<tr>
<td>GHG</td>
<td>Greenhouse Gas</td>
</tr>
<tr>
<td>GWh</td>
<td>GigaWatt hours</td>
</tr>
<tr>
<td>HSE</td>
<td>Health Service Executive</td>
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<tr>
<td>IPCC</td>
<td>Intergovernmental Panel on Climate Change</td>
</tr>
<tr>
<td>ITS</td>
<td>Intelligent Transport Systems</td>
</tr>
<tr>
<td>kWh</td>
<td>kiloWatt hours</td>
</tr>
<tr>
<td>kt</td>
<td>kilotonne</td>
</tr>
<tr>
<td>ktoe</td>
<td>kilotonne of oil equivalent</td>
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<tr>
<td>LEV</td>
<td>Low Emission Vehicle</td>
</tr>
<tr>
<td>LULUCF</td>
<td>Land Use, Land Use Change and Forestry</td>
</tr>
<tr>
<td>Acronym</td>
<td>Definition</td>
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<tr>
<td>---------</td>
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<tr>
<td>MW</td>
<td>MegaWatt</td>
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<tr>
<td>Mt</td>
<td>Million tonnes</td>
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<tr>
<td>NAF</td>
<td>National Adaptation Framework</td>
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<td>NEEAP</td>
<td>National Energy Efficiency Action Plan</td>
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<td>NDC</td>
<td>Nationally Determined Contributions</td>
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<td>NDCA</td>
<td>National Dialogue on Climate Action</td>
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<tr>
<td>NMP</td>
<td>National Mitigation Plan</td>
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<tr>
<td>NZEB</td>
<td>Nearly Zero Energy Buildings</td>
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<tr>
<td>N₂O</td>
<td>Nitrous Oxide</td>
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<tr>
<td>OREDP</td>
<td>Offshore Renewable Energy Development Plan</td>
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<td>PSO</td>
<td>Public Service Obligation</td>
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<tr>
<td>REFIT</td>
<td>Renewable Energy Feed-in Tariff</td>
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<tr>
<td>RHI</td>
<td>Renewable Heat Incentive</td>
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<tr>
<td>SEA</td>
<td>Strategic Environmental Assessment</td>
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<tr>
<td>SEAI</td>
<td>Sustainable Energy Authority of Ireland</td>
</tr>
<tr>
<td>SME</td>
<td>Small and Medium Enterprises</td>
</tr>
<tr>
<td>TRAM</td>
<td>Technical Research and Modelling Group</td>
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<tr>
<td>UNFCCC</td>
<td>United Nations Framework Convention on Climate Change</td>
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<tr>
<td>VRT</td>
<td>Vehicle Registration Tax</td>
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